Railway Mechanical Engineer

VOLUME 94, NUMBER 10 — New York—OCTOBER, 1920—Chicago — ESTABLISHED IN 1832

Published Monthly by Simmons-Boardman Publishing Co., Woolworth Building, New York, N. Y. Subscription price, United States, Canada and Mexica, $4.00 a year; foreign countries, $5.00 a year; single copies 35c. Entered as second-class matter, January 27, 1916, at the post office at New York, N. Y., under the act of March 3, 1879.

Railway Mechanical Engineer

Volume 94 | October, 1920 | No. 10

CONTENT

THE CONVENTION NUMBER

SEPTEMBER is growing in popularity as the season for conventions of the mechanical associations. During one week last month, three railroad organizations met simultaneously in Chicago, Boston and Montreal, and at the same time the Society for Steel Treating, which numbers many railroad men among its members, was in session in Philadelphia. Under these circumstances it is difficult for the mechanical department officer to decide which meeting to attend and no doubt many were unable to be present at conventions in which they were vitally interested. The activities of the associations are of such importance to the readers of the *Railway Mechanical Engineer* that the editors felt it advisable to publish the full reports as promptly as possible. For that reason this issue is devoted principally to the proceedings of five of the associations that met last month and on the following pages will be found editorials commenting briefly on the outstanding features of the conventions. The account of the meeting of the Chief Interchange Car Inspectors' and Car Foremen's Association could not be included in this number because of delay in getting out the stenographic report. A movement is now under way to arrange for holding several conventions in the same location during successive weeks next year. This will not only be convenient for the supply concerns, but will also do away with having several conventions meeting at the same time.

Amalgamation of Mechanical Associations

The question of amalgamation with the American Railroad Association as divisions of Section III-Mechanical has been before practically all of the so-called minor mechanical department organizations. Definite action has already been taken by the Master Painters' Association, now the Equipment Painting Division of Section III-Mechanical, and by the American Railway Tool Foremen's Association. The Air Brake Association and the Master Blacksmiths' Association have acted favorably on the proposal, subject to ratification of the final negotiations at next year's conventions. No definite action has been taken by the other organizations. There is a natural reluctance on the part of the minor organizations to lose their identity and there are good grounds for justification of this attitude. It must be remembered that these associations were not organized by the railroads. They owe their existence to the enterprise of leaders among the men in the fields represented and such railroad support as they have secured has been earned by a demonstration of the value to the railroads of such organizations. Under these circumstances the desire to retain their identity and a high degree of freedom of action must not be condemned. On the other hand it must be admitted that the value of their work to the railroads could be greatly increased if the energy of the various associations were to be directed so that less overlapping and better co-ordination would result. The principal value of the associations to the members themselves is educational; and while they serve this purpose very well, it undoubtedly could be equally well served, were they to become parts of an organization which would make their work of much greater value to the railroads. It must be said that the committee investigations of the independent associations are seldom authoritative as now conducted and there are many big problems that should be analyzed which the associations are not in a position to handle with their present organizations. Under the plan of organization proposed by the American Railroad Association the individual associations retain "home rule" and a large measure of their identity. For such sacrifices of sentiment as they make they receive in return the assistance of the secretary of Section III-Mechanical, an opportunity to do more effective work and the prospect of good work receiving a recognition which it is not now accorded. The invitations extended by Section III-Mechanical present opportunities which the minor organizations can ill afford to pass by.

THE TRAVELING ENGINEERS' CONVENTION

THE Traveling Engineers' Association may not be the most technical, but it is assuredly one of the most practical of the railway mechanical associations. Moreover, it has the reputation of being one of the hardest working bodies and the recent convention in Chicago was no exception to the rule.

* * *

Fuel Economy in the Lime Light

First and foremost in recent meetings of this association comes the fuel problem, the question of obtaining the maximum use out of every pound of coal. At this convention the operation and maintenance of mechanical stokers was considered from the viewpoint of *efficiency* and *economy*. Stoker manufacturers know that the locomotive stoker must live down the reputation of being an excessive fuel consumer. Spark losses with stoker operation are high and every effort must be made to eliminate this and other waste incident to the use of mechanical stokers. The secret of efficient stoker operation lies in the education of firemen. The stoker is automatic only in a limited sense; it will not perform efficiently unless handled intelligently.

* * *

The Thermic Syphon

Locomotive boilers have never been designed with a view to promoting circulation, although this is always the first consideration in the design of efficient water tube boilers for power plant practice. Limitations with respect to size and capacity have governed locomotive boiler construction and water circulation has developed in just about the same manner that "Topsy" grew up. The principal claim for economy and increased boiler capacity with the application of the thermic syphon lies in the fact that it creates a defined path for circulation in addition to increasing the evaporating surface of the firebox. Some excellent results are being obtained with this device as outlined in one of the most interesting papers presented at the convention.

* * *

The Back Pressure Gage

Notwithstanding the fact that the effect of excessive back pressure on the operation of locomotives is well known, it has been given little attention in practical locomotive operation. The primary object of adjustments of draft appliances is, of course, to improve the steaming of the locomotive, and so long as steam enough can be generated to do the work little attention is paid to the effect of the adjustments on the steam economy of the engine proper. Back pressures as high as 20 lb. and 25 lb. are not infrequently attained in every day service and seldom are disclosed so long as the locomotive maintains schedules or handles its tonnage. It is true that there is a growing dissatisfaction with the status of our knowledge of the locomotive front end, but it has not yet reached the point where the railroads are willing to take the measures necessary to place front end design on a scientific instead of a rule-of-thumb basis. As a means of disclosing just how bad conditions are the use of the back pressure gage mentioned in the report of the committee on draft appliances of the Traveling Engineers' Association is worthy of general application. The device is nothing more than a pressure gage in the cab, connected by suitable branch pipes to the exhaust cavities of the cylinders. Ultimately the greatest return from the use of this device undoubtedly would be the sentiment its disclosures would create in favor of a scientific investigation of the whole problem of locomotive drafting. But it would also be of immediate value in comparing draft conditions on various locomotives of the same class; it would show why some locomotives are unable to maintain schedules well within the capacity of others of like design.

THE PROBLEMS OF THE GENERAL FOREMEN

ALMOST every craft and every department of the railroad shop has a separate association which considers and reports on its own specialized branch of the work; in fact, the field might seem to be covered so thoroughly that there is little left for the General Foremen's Association to discuss. Undoubtedly the activities of this association should be devoted, not to the details of shop practice, but rather to the broad question of management. At the last convention more than ever before this underlying idea was brought out.

* * *

Handling the Labor Problem

Probably no single question has caused so much concern to those who are responsible for shop output as the problem of handling men. There is no doubt that on the whole there has been a falling off in output per man during the past four years and even increased wages have had little effect in speeding up production. The reason is probably to be found in the feeling of unrest that has been almost universal during the last few years. Efforts to overcome the decrease in output have often been unsuccessful because the decreased production was a result of general conditions. Apparently the turning point has come and improvement should be apparent within a short time. The present wage scale is satisfactory to a great majority of the employees. Reductions in prices give promise of a decrease in the cost of living and with slack times in numerous industries, the employees will realize the benefit of the continuous employment which railroad service offers. Nevertheless the handling of men will continue to be a problem. The day of the boss, the driver, is gone. To get results under present conditions the foreman must be a leader, one who can appeal to the men through a study of the motives that spur them to action. Even with the unfavorable conditions existing during the past two years some shops have made remarkable records in maintaining their output. Under present conditions it should be easier to obtain the desired results.

* * *

The Operating Viewpoint

That the General Foremen's Association is looking beyond the internal problems of the shop is shown by the discussion of engine failures and running repair costs. The ultimate object in conducting a railroad is to produce transportation at the lowest cost per ton mile and per passenger mile. The mechanical department officer can best help to insure economical operaton if he keeps this constantly in mind. Too many records for low cost of classified repairs have been made by slipshod methods which have resulted in loss of service and heavy expenditures for running repairs. In view of the practical impossibility of keeping a record of running repair costs for individual engines as is done in back shop work, the cost of classified repairs should not be taken as the most important index of the efficiency of the mechanical department. Tests have shown that even slight defects in valve gears, valves and pistons will cause a considerable increase in the fuel consumption. Failure to make minor repairs promptly is often responsible for engine failures. The few dollars that may be saved in making classified repairs are lost many times over if the work is slighted and the expenditures for fuel and for wages of train crews are increased. Another angle of the maintenance problem that deserves attention is the matter of clean engines. It is natural for enginemen to take pride in such a wonderful piece of machinery as the modern locomotive, but if the whole engine is covered with filth it becomes repulsive and in that condition the engineman is almost certain not to give the machinery the minute and painstaking attention that is so essential for securing the best results.

THE PAINTERS' CONVENTION

Of the several conventions held during the month of September, the meeting of the Equipment Painting Division of Section III-Mechanical, at Boston, was in many respects the most interesting because it marked the fiftieth anniversary of the association that has been known for many years as the Master Car and Locomotive Painters' Association.

* * *

Regarding Substitutes for Turpentine

From the chemical standpoint the most important problems in regard to paint relate to the manufacture and use of substitute materials for the more expensive elements that for years have been regarded as essential to the manufacture of high grade protective and decorative coatings. Turpentine has become a very expensive ingredient in paint; and when it is realized that it is not a permanent element in the finished surface but rather a vehicle assisting in the mechanical application of the paint it seems logical that among the multitude of available petroleum products a distillate could be found which would serve the purpose. Opinion at the convention varied as to the efficacy of these substitutes, but it should be noted that the representative of at least one very important railroad declared in favor of a substitute for turpentine and stated that he was using this material on an extensive scale with entirely satisfactory results. The railroads are striving for economy in every direction and the painters should lead rather than follow in the procession. Those who object to the use of a substitute for turpentine should make sure of their ground before advising their railroads that a cheaper substitute cannot be successfully used.

* * *

Use Only the Best Materials

Sentiment at the Painters' Convention was strongly in favor of using only the best materials. Any material which tends to lessen the durability of the painted surface is costly because it increases the labor that must be expended in the upkeep of the car and labor is a much more expensive item these days than paint. It would be extremely costly to use inferior materials that made it necessary to paint a car more frequently than if better materials had been applied or to use cheaper materials that allowed the steel surface to deteriorate when more expensive materials would have prevented the damage. These considerations in turn suggest the interesting question as to whether the quality of paint can be wholly determined by a chemical formula. There are many who contend that the preparation of paint is an art and that only the most skilled artisans are capable of mixing the ingredients in such proportion as to obtain a satisfactory paint. The technical staff of the Railroad Administration prepared specifications upon which all of the paint required for the standardized equipment was purchased. Some complaints were registered at the time, but the paint purchased was generally well regarded. It would be very interesting to know how this paint has stood the test of time.

* * *

Uniform Stencilling Endorsed

The most practical and progressive action taken by the painters at this convention was in regard to the uniform stencilling of freight cars. This was unanimously endorsed and the action of the association was also in favor of placing upon the owning road the cost of painting special badges or trade marks. It was shown that the cost of this special decorative work was considerable and that uniform stencilling would result in a considerable saving to all roads if universally adopted. It appears that many railroads have already adopted the uniform stencilling.

THE TOOL FOREMEN'S CONVENTION

At the tenth annual convention of the American Railway Tool Foremen's Association, held at the Hotel Sherman, Chicago, September 1 to 3 inclusive, definite affirmative action was taken on the question of amalgamation with the American Railroad Association, Section III—Mechanical The tool foremen, therefore, became the second of the so-called minor mechanical department organizations to join the American Railroad Association. The convention was well attended and technical reports and papers of exceptional value were read, followed in many cases by animated discussions.

* * *

Special Tool Room Devices

Several papers were presented on special tool room devices and it developed that there are few tool room foremen who do not have a number of special and effective devices for performing various operations in the shop. These devices should be made known to other foremen through the medium of the association and various technical journals. It was pointed out that the future of the tool room foreman lies not in his ability to turn out satisfactory small tools and machine tool cutters, but in the extent to which he studies the problems of the other departments of the shop with a view to developing special jigs and tools to reduce the time and labor required on machine and erecting floor operations.

* * *

Method of Issuing Shop Tools

Members who took part in the discussion of the paper on "Issuing and Checking Tools in Locomotive and Car Shops" were practically unanimous in support of the system of issuing by check number. Checks given to the men on entering the service should be presented at the tool room for all tools except chisels and machine tools. Periodical inspections of cupboards will serve as a check on the operation of the system and at the same time bring to light many tools that are being hoarded by mechanics against possible use. This condition is especially evident when there is a shortage of any particular kind of tool. Irregularities and disobedience of shop rules regarding the handling of tools should not be allowed to pass unnoticed.

* * *

Standardization of Boiler Taps Recommended

Especial interest was displayed in the report of the Committee on Standardization of Boiler and Staybolt Taps given in detail elsewhere in this issue. Seven standard taps were recommended, including a 36-in. staybolt tap, a special spindle tap for work behind frames, a 24-in. staybolt tap made in three lengths and a button-head radial staybolt tap. These first four taps are made with Whitworth threads, 12 per in., this thread being recommended because it has a greater tensile strength and maintains its original diameter longer than either the V-thread or the U. S. Standard. It was pointed out that staybolt cutting machines must be checked often to make sure they are cutting accurate staybolt threads of the correct diameter. Boiler head and washout plug taps were recommended with a ¾-in. taper in 12 in. and 12 U.S. standard threads per in., the latter provision being made because these taps are often manufactured in railway shops and the U.S. standard thread is less difficult to make than the Whitworth. The committee maintained that the adoption of standard taps as recommended would eliminate many irregularities and simplify the manufacture of taps for this particular service. It was also felt that under present conditions satisfactory taps can be secured at a more reasonable price from any first class manufacturer than can be made locally in a railroad shop.

THE STEEL TREATERS' CONVENTION

THE truth of the old motto "In union there is strength" seems to be demonstrated once more by the amalgamation of the American Steel Treaters' Society and the Steel Treating Research Society to form one big organization of men interested in steel treating. The new organization, known as the American Society for Steel Treating, springs at once into prominence among the American technical societies; its remarkable growth and strength were convincingly shown at the second annual convention and exhibition held at Philadelphia, September 14 to 18. Many valuable papers, some of which are abstracted in this issue, were read and presented by title at the technical sessions. With an exhibition distributed over 80,000 sq. ft. of floor space, practically every phase of the heat treating industry was represented. The present membership of the society is estimated at 2,800, more than one-half of whom attended the convention.

* * *

Relative Efficiency of Fuels

Several papers were presented on the relative efficiency of fuels and special emphasis was laid on the high cost and growing scarcity of fuel oil. Discussion brought out the fact that the average fuel oil furnace without proper equipment for vaporizing the oil, mixing it with air, and a pyrometer to indicate temperatures, wastes at least 33 per cent of the heat of the oil. This statement was made by competent authorities and indicates the importance of proper fuel mixing and temperature control apparatus to increase the efficiency of furnace operation. Owing to the fuel oil situation, the possible necessity of changing over to gas or electric furnaces was pointed out, with resultant advantages in greater flexibility, better control of furnace atmosphere and more uniform temperature of heated area.

* * *

Conclusions Regarding Fatigue Strength

A question of particular interest to railroad men in view of the attempted use of heat treated steel for locomotive motion work was brought out in the discussion of heat treatment and fatigue strength of steel. The conclusions were that there is only one quenching and one drawing temperature for maximum fatigue strength. Decarbonization has a detrimental effect on fatigue strength and parts should be heated in a non-oxidizing atmosphere. Duplication of regular heat treatment will hasten failure of such parts as have already been subjected to repeated stresses. It was pointed out that these conclusions hold for carbon steel and not necessarily for all alloy steels.

* * *

Heat Treating High Speed Steel

The discovery of high speed steel by two American metallurgists, Taylor and White, revolutionized the steel treating industry and made possible production records never before thought of. The best results with any kind of tool steel, however, can be secured only by proper heat treatment. Several papers were presented on the heat treatment of high speed steel and showing the results of actual tests. The imperative need for better shop equipment for heat treating steel was pointed out. Altogether aside from the question of fuel economy, high speed steel is too expensive to be spoiled or heat treated in such a way as to secure any but the best results. Antiquated equipment together with guess-work methods of judging temperatures and treating the steel must be done away with because they result in inefficient or spoiled work, the cost of which may often equal the entire cost of the right kind of equipment. Money can be saved in many shops by the installation of modern forging, annealing, carburizing and heat treating furnaces; also the temperature control apparatus, pyrometers and other equipment necessary for their efficient operation.

COMMUNICATIONS

PIECEWORK AND PRODUCTION

Roselle Park, N. J.

To the Editor:

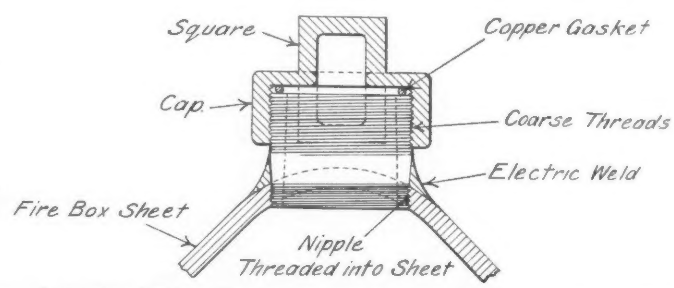
The article in the July issue of the *Railway Mechanical Engineer* entitled "Piecework Needed to Increase Production" has been sharply criticised by the railway shop crafts on the ground that it misrepresented the American workman and advocated obsolete methods to increase production. The writer had no such intention, well knowing that when compared with the workers of other countries, the American workman excels in many ways, as was forcefully proved during the recent war.

Regarding the piecework system, the underlying idea was simply that special skill and ability should be specially rewarded or compensated for, which in the writer's opinion could be best accomplished by a proper bonus system. However, since any system in order to be a success must be agreeable to the railway shop crafts, otherwise no co-operation on their part could be expected, it logically follows that the piecework system, being objected to by the majority of them, cannot be considered.

The most essential thing today in railroad shops is co-operation between the officials, supervisors and shop crafts. This, combined with loyalty to service will bring out inventive genius and constructive ideas on the part of the mechanics and supervisors. Frank J. Borer.

HANDHOLDS VS. WASHOUT PLUGS

In the September issue of the *Railway Mechanical Engineer* on page 567, there appeared a letter on the above sub-



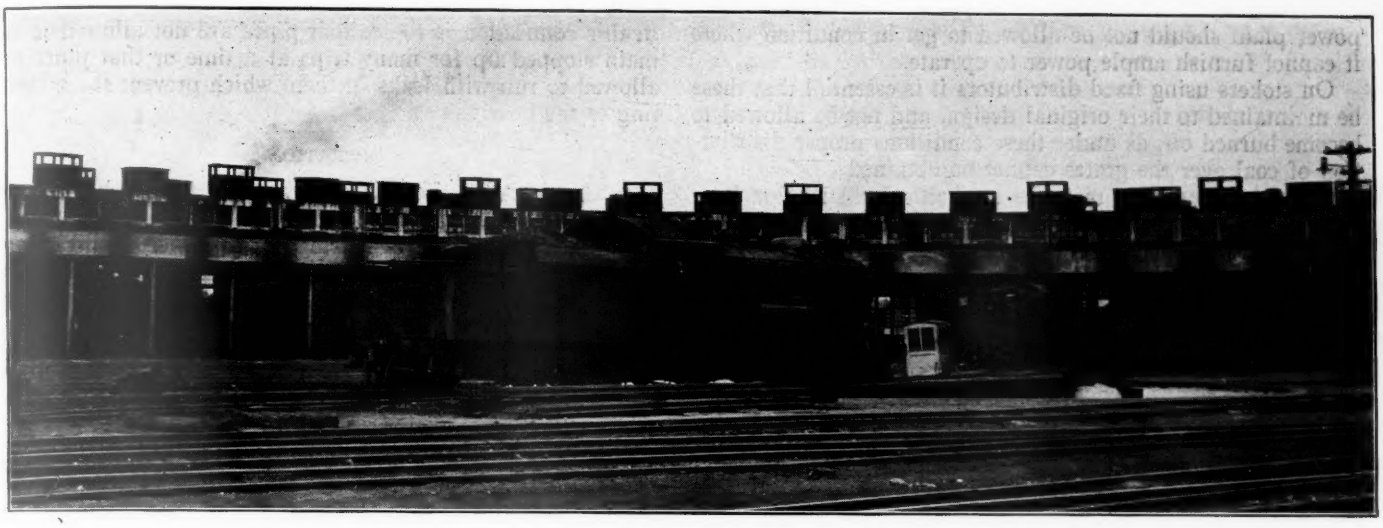
A Design Which Eliminates Many of the Defects of Ordinary Washout Plugs

ject by J. L. Mohun. The illustration of the washout plug referred to in the letter was not published and it is therefore shown herewith.

NEW BOOKS

Metal Statistics, 1920. 328 pages including advertising, 3½ in. by 6 in., bound in cloth. Published by the American Metal Market and Daily Iron and Steel Report, 81 Fulton street, New York.

This book probably contains the most complete data concerning metal prices and production for many years past that is available in the form of a pocket handbook, and as such the book may be recommended to railroad purchasing agents concerned with metal purchases; although in the present erratic state of the market for all basic commodities, a study of previous price fluctuations would not appear to be of much value as an index to future price levels. The book does not contain any technical information relating to metals. does not contain any technical information relating to metals and is in no sense of the word a text book on metallurgy to be used by students.



TRAVELING ENGINEERS' ASSOCIATION CONVENES

Well Attended Meeting Discusses Operation of Stokers, Draft Appliances and Many Other Subjects

THE Traveling Engineers' Association held its twenty-eighth annual convention at the Hotel Sherman, Chicago, September 14 to 17, 1920. Following the opening exercises the President's address was delivered by G. A. Kell, (Grand Trunk).

Address of President Kell

President Kell spoke in part as follows:

During the great war special efforts were made by each and every man employed in the operation of railroads to conserve coal in particular and to operate the railroads at the lowest possible expense. In this the traveling engineer took no small part. Many of our members have been called on to take up important positions in connection with this matter.

It is just as important today to save coal and supplies as it has ever been. The cost of coal, oil, and supplies of all kinds is greater today than it has ever been before. Therefore there should be no relaxation on our part in any way, but every effort should be put forth to get more skillful operation of the locomotives on the road.

The drastic labor conditions that prevail throughout the country are the cause for great anxiety. There is social, racial, and industrial unrest everywhere, brought about to a great extent by the spirit and practice of profiteering and the high cost of living. Strikes have taken place; in some cases they have been due to over zealous, self-appointed labor leaders more than to anything else. The traveling engineers, whose conservatism and loyalty have never been questioned, who are scattered throughout the different parts of the country and who come in contact with a great many railroad employees, can do much toward influencing the rank and file of the men toward taking the right view of the present critical conditions. If ever there was a time in the world's history when calm and cool judgment should be exercised, now is the time.

OPERATION AND MAINTENANCE OF LOCOMOTIVE STOKERS

Because the stoker is comparatively new to the men, the organization of proper terminal inspection forces has been neglected on many roads. It is considered sufficient to assign a few mechanics to the task of working up the reports made out by the engine crews. A great deal of essential work is reported by the engine inspectors which was not found by the enginemen, and it is but natural to assume that without an inspection of the stoker by a competent inspector this machine will be allowed to continue in service many trips when in need of repairs. The stoker inspection force should be modeled along the lines of our present air brake inspection, and when this is done we will notice a large decrease in the number of so-called stoker failures.

There should be a man at each terminal who is held personally responsible for the condition of all stokers, and he should have a sufficient force of mechanics under his supervision to properly maintain and inspect the number of stokers handled. We can never hope to give stokers the attention deserved while we depend on a busy roundhouse foreman to give them what attention he is able to spare from his other duties.

When an engine arrives at the terminal or cinder pit track, there should be an inspector whose duty it is to run the stoker and observe all features of its operation, both from a mechanical viewpoint and also the manner in which it performs its various functions in order that any defects existing may be corrected before the engine is called to leave. Inspections which are left to be performed on the outgoing track often mean defects, cannot be corrected without delaying the engine, and as a result the engine is permitted to go without the work being done.

In most cases many important parts of the stokers are placed below the engine deck, and no attention is paid to the accumulation on them of coal and grease, with the result that it is nearly impossible to determine just what the machine looks like. If the machine is allowed to become buried, the roundhouse forces have good grounds for presuming that it is not of much importance and they lose interest in its upkeep.

MAINTENANCE

On the question of maintenance organization your Committee does not feel that any fixed rules can be laid down, as this is a matter which must be determined by local conditions and the number of stokers in service. The one vital point is that the organization must be such as to assure the maintaining of the stokers in good operating condition at all times.

Power being the first essential to operating the stoker, the

power plant should not be allowed to get in condition where it cannot furnish ample power to operate.

On stokers using fixed distributors it is essential that these be maintained to their original design, and not be allowed to become burned off, as under these conditions proper distribution of coal over the grates cannot be obtained.

On stokers using a movable mechanical distributor it is equally important that this be kept in good condition, and lost motion not allowed to develop.

When an engine goes into the shop for heavy repairs, the stoker should be removed from the engine and receive the same careful attention and overhauling which other devices get at such times, in order that when the engine is returned to service the stoker will be physically fit for the arduous duties it is called upon to perform.

G. A. Kell—Grand Trunk
President

Wm. E. Preston—Southern
1st Vice President

L. R. Pyle—Locomotive Firebox Co.
2nd Vice President

W. O. Thompson—New York Central
Secretary

D. Meadows—Michigan Central
Treasurer

LUBRICATION

The practice of equipping stoker-fired engines with a separate lubricator for oiling the steam cylinder of the stoker engine has been tried out with success, and the Committee recommends that this receive consideration. It has been found that this method not only excites more interest on the part of the fireman in the care of the machine, but also is an education to him in the operation of lubricators which he will be called upon sooner or later to handle.

Many parts and bearings of the stoker depend on oil cups for their lubrication, these cups oftentimes having pipe connections to the parts affected. If these cups are allowed to be taken off of the engine or be lost, the parts will run without oil and before this is detected, will be worn to such an extent as to require renewal. Another very important feature in this connection is to see that pipes are not allowed to remain stopped up for many trips at a time or that pipes are allowed to run with leaks in them which prevent the oil getting to the bearings.

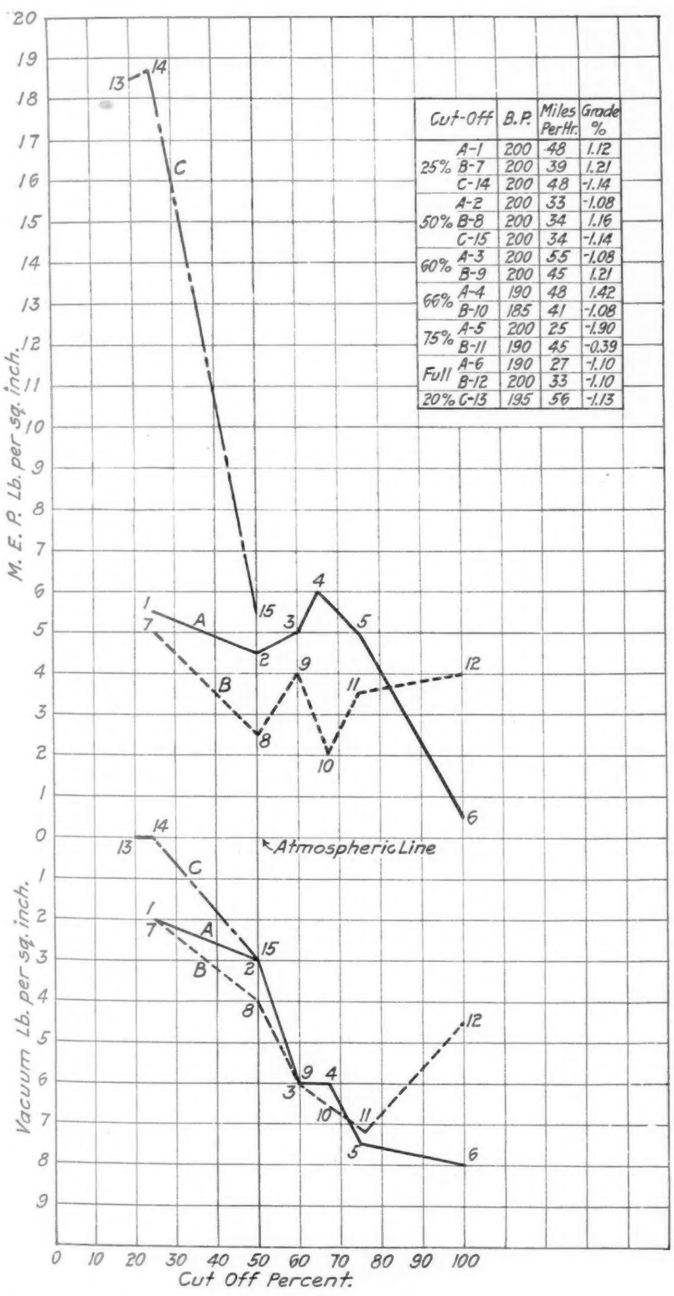
OPERATION

In the preparation of fires for the road, too much care cannot be taken in order that the stoker has a fire in proper condition on which to start firing. The stoker is only a machine, and not an automatic one. It will do only what it is made to do by human hands, so if the fireman starts it to work without having first put the fire in proper condition the stoker is in no way to blame for a poor performance. In the preparation of fires at terminals, hand firing only should be used. All banks should be leveled off by using the rake and the fire be allowed to burn through uniformly over the entire grate area before using the stoker. Many delays due to having to clean fires on the road are caused by no other reason than that the fireman did not get his fire in condition before starting and a clinkered fire was the result. Light fires are recommended for stoker-fired engines, but whether the fires are light or of medium thickness, it is necessary that they be burned uniformly over the grates before starting.

After starting, the fireman should endeavor to starve the conveyor trough whenever this is possible, as this will enable him better to observe any foreign matter which might enter the trough with the coal. Practically all firemen have been instructed and are practicing the art of starving the fire while the engine is working, and this method of firing has proven entirely satisfactory.

Firemen should be able to foresee the steam requirements

of their engines and maintain an even steam pressure with regular operation of the stoker, rather than run the stoker fast for a few minutes and then stop until the fire has burned through. The latter method is very wasteful of fuel. The use of the stoker to replenish the fire when rolling down grade, standing on passing tracks or when switching, should be discouraged, as the fireman should avail himself of these opportunities to become acquainted with the condition of his fire. Firemen should not be allowed to speed up the stoker in an attempt to build up certain parts of the fire but should use the shovel for this purpose.



Cut-Off		B.P.	Miles Per Hr.	Grade %
25%	A-1	200	48	1.12
	B-7	200	39	1.21
	C-14	200	48	-1.14
50%	A-2	200	33	-1.08
	B-8	200	34	1.16
	C-15	200	34	-1.14
60%	A-3	200	55	-1.08
	B-9	200	45	1.21
66%	A-4	190	48	1.42
	B-10	185	41	-1.08
75%	A-5	200	25	-1.90
	B-11	190	45	-0.39
Full	A-6	190	27	-1.10
	B-12	200	33	-1.10
20%	C-13	195	56	-1.13

Summary of Test Results Showing Vacuum and Mean Effective Pressure Obtained With Throttle and Drifting Valves

When any foreign matter gets into the stoker the fireman should try to locate and remove it, rather than to try to force the obstruction through the machine.

When delivering an engine at the terminal all coal should be allowed to run from the conveyor trough and the slides should be closed in order that the engine will not be coaled with the slides in the back of the tender open and the trough become jammed with coal during this operation. The fireman should not wait until the engine is detached from the train and about to reach the cinder pit before closing the slides over the conveyor trough, for in this case he wastes the coal by putting it into the fire-box when it is not needed and makes the task of the fire knockers much harder than it would be otherwise.

Wonderful progress has been made in the economical handling of stokers in the past two or three years. The present-day stoker is efficient and economical in its performance when given the proper care and skillful handling.

The report was signed by I. T. Burney, chairman (Southern); O. W. Detrick, (L. V.); J. H. Harry, (Wabash); C. M. Freeman and W. A. Larick, (N. Y. C.).

Discussion

The lubrication of stokers was the point most generally discussed. Many of the members recommended the use of a separate lubricator for the stoker engine placed on the left side of the boiler head where it can be regulated by the fireman. While good results have also been obtained by the lubrication of the stoker engine from the main lubricator, the separate lubricator has the advantage of placing the entire stoker in the hands of the fireman, increasing his interest and preparing him for greater responsibilities on promotion.

In answer to questions which were raised as to the advantages of the stoker as compared with hand firing, the fact was brought out that in very few cases are hand fired and stoker fired locomotives of the same classes in service to permit directly comparable tests. While such tests as have been made by members of the Association indicate an increase in the coal consumption per locomotive mile this has been accompanied either by an increased tonnage, increased speed or both. In one case mentioned the increase in speed has been an important factor in reducing the average time of freight runs over the division from 15 and 16 hours to about 7 or 8 hours. The importance of carefully training stoker firemen was touched on by several members. The points most needing attention in this respect are care in cutting down the rate of coal feed to the minimum; that is, "starving" the trough, and the judicious use of the shovel in building up fires for the stoker and in keeping them trimmed. The reliability of the stokers now in service was quite generally testified to, very few failures occurring which are legitimately chargeable to the machine.

BY-PASS RELIEF AND DRIFTING VALVES

The subject covers three distinct appliances used on locomotives, all of which, though differently constructed, tend to serve practically the same purpose. This is the elimination of vacuum in the steam chest and cylinders and the prevention of the suction of smoke-box gases through nozzle tips into the steam chests and cylinders, which tends to destroy lubrication when the throttle is shut off and the engine drifting.

By-pass and drifting valves are used only on piston valve engines, while the relief valve is used with the slide valve as well as the piston valve.

RELIEF VALVE

The relief valve opens direct communication between the steam chest and the atmosphere when the throttle is closed, admitting air into the steam chest at atmospheric pressure, this air being admitted to and exhausted from the cylinders the same as steam when the engine is drifting. In this way the vacuum created by piston action in the cylinders is destroyed.

On saturated engines, either of the slide or piston valve

type, this valve is of advantage for the reason that in its absence the vacuum created in the cylinders by the piston action would be filled with smoke and gases from the smokebox. It is well known what that means to lubrication. However, with the advent of superheat it was soon realized that air must be excluded from the steam chest and cylinders due to the high temperature developed in the steam chest and cylinders by the superheated steam. This valve is a detriment on superheated engines, except possibly on mountain roads where engines drift for miles at a time and are cushioned by means of the throttle. When the superheater damper is closed the engine will work saturated steam so where the damper can be regulated to drop with still enough steam to cushion the engine for some distance the saturated steam will soon cool the cylinders down so that the engine may be shut off. On long and heavy grades this will not only save fuel, but be a factor of safety that is worthy of consideration. When engines are cushioned by means of the throttle, it is essential that all lost motion be taken up in the throttle rigging and that it be sensitive so that the engineer can judge just what he is doing.

BY-PASS VALVES

There are a number of different types of by-pass valves, but practically all function the same. They are held closed by steam pressure when the engine is working steam, and when the engine is drifting the by-pass valve opens and establishes communication between both ends of the cylinders and the interior of the valve chamber, thus equalizing the pressure. Theoretically the principle of this valve is good, but experience shows that it does not always work out in practice, as the speed of the engine, the size of the cylinders and the area of the by-pass valves are factors that govern how effectively they fulfill the claims made in their behalf. The fact that they destroy compression, which many authorities on locomotives feel is essential to take care of the reciprocating parts when the engine is drifting, has caused some roads to discard them. However, there is a vast difference of opinion on the advantages and disadvantages of both the by-pass and the relief valve on piston valve engines; some roads are doing away with the relief valve and retaining the by-pass valve, others are doing just the opposite, others are doing away with both and still others retaining both.

DRIFTING VALVES

With the advent of superheat on locomotives it was soon realized that air must be excluded from the steam chests and cylinders. As a result, many forms of drifting valves have been developed and are now in use.

The function of the valve is to admit sufficient steam to the cylinders when the throttle is closed and the engine is drifting to prevent the formation of a vacuum in the steam chest and cylinders. Some of them are applied to the steam chest or steam channel, others to the cylinders direct; some are automatic and others are operated mechanically. In those applied to steam chests or channels, the steam admission to the cylinders is controlled by the main valve and if drifting is done at too short a cut-off the amount of steam admitted is of such a small volume that expansion may bring the pressure below that of the atmosphere, in which case a partial vacuum would be created which would tend to draw smokebox gases into the cylinders. Therefore it is better to have the drifting valve attached direct to the cylinders.

DRIFTING VALVE TESTS

The St. Louis-San Francisco ran a test of about 1,400 miles on a passenger engine having 26½-inch by 28-inch cylinders and 73-inch driving wheels over a 238-mile passenger division which has many heavy grades, making it necessary to drift the engine frequently. Two different types of drifting valves were used and a number of cards were also taken with the drifting valve shut off and the engine cushioned with the throttle.

Valve A is a homemade device. It consists of two differential pistons with a piston valve attached to the operating piston, which admits boiler pressure on top of the other differential piston when the engine is working steam, to keep this valve in closed position. When the throttle is shut off the differential valve with operating piston is moved up by boiler pressure under the small end of the operating piston. The movement of this differential piston allows steam to exhaust from the top of the second piston, raising it from its seat and allowing steam from the dome to pass into the steam chest. The size of the steam pipe from the dome to a point back of cylinder saddle is 1½ in., where it connects with a tee, and from this point to the drifting valve 1¼-in. pipe is used. The 1½-in. pipe has a globe valve at the dome. When the engine stops, steam is admitted to the top of the differential with the operating piston through a pipe connection in the steam chest, moving it down and carrying the valve with it. This admits steam on top of the second piston, closing the valve. This valve is supposed to work as soon as the throttle is closed.

Valve *B*, which is a commercial device, has similar steam pipe connections, with the exception that the pipe from the tee connection to the valves is 1 in., and it consists of one large differential piston. When the engine is working steam the differential piston is held down, covering the steam port opening from the pipe to the steam dome. When the throttle is shut off, the vacuum moves the differential piston, opening communication between the steam pipe and steam chest and allowing steam to pass direct from the dome to the steam chest.

On the chart the solid lines show the results obtained by Valve *A*, the dotted lines Valve *B* and the dash and dot the throttle drift. During the test Pennant valve oil was used. The lubricator was set at five drops per minute to each valve and one drop to the air pumps. The oil was measured at the end of the trip and it amounted to an average of three pints per trip of 238 miles or about 79 miles to the pint. Piston rods were watched closely during the test, always showing good lubrication. The cylinder heads were removed after the test of each valve and were found to be free from carbonization and well lubricated.

During the test with both types of drifting valves the throttle was shut off completely, the same as would be done with a saturated steam engine, anywhere the train would roll and make the time.

While there was not an indicator card taken that did not show some vacuum, it is evident from the way the engine was lubricated that there was an advantage gained by the use of either type of drifting valve. Further, it can be seen that the best results were obtained with both valves at a 25 per cent cut-off. At this cut-off the mean effective pressure was the greatest and the vacuum the least. The throttle drift at 20 per cent and 25 per cent cut-off showed no vacuum, but the mean effective pressure was rather high for good practice. The 50 per cent throttle drift shows a vacuum which indicates not enough mean effective pressure, demonstrating that where the throttle, its rigging or the engineer's judgment are not of the best, results are likely to go from one extreme to the other, either of which is detrimental.

A drifting valve must be so designed as to take care of the worst conditions that can arise, which is generally admitted to be a combination of high speed and short cut-off, as it is under such conditions that the greatest damage is done. A drifting valve to be effective should automatically close when the engine is working steam, automatically open the instant the throttle is closed, and automatically close when the engine comes to a stop. It should have as few working

parts as possible, and these should be properly cushioned or otherwise protected from shocks due to rapid fluctuations in pressure.

The report was signed by J. D. Heyburn, chairman (St. L.-S. F.); A. G. Newell (E. P. & S. W.), N. Suhrie (Penn.), W. Sharp (G. T.) and D. C. Dickert (Sou.).

Discussion

Considerable difference of opinion was expressed as to the cause of carbonization in the cylinders of superheater locomotives. While the flash temperature of the cylinder lubricating oils used with superheated steam is low enough so that carbonization might be expected when air is admitted to the cylinders following the closing of the throttle, as it would be through a release valve, the experience of some of the members seems to justify the opinion that, practically, carbonization is much more likely to be due to deposits from the front end gases drawn into the cylinders through the exhaust passages when drifting with neither relief nor drifting valve equipment.

The Whalen combined relief and by-pass valve was referred to and it was described by the inventor. Two of these valves are installed, one in pipe connections, leading from each port passage to the live steam cavity of the valve chamber. When drifting, the valve automatically opens the by-pass connection and at the same time opens a passage to the atmosphere, the area of which can be adjusted. The usual adjustment calls for 50 per cent by-pass and 50 per cent relief valve action. A service of two years has indicated a material saving in repairs to reciprocating parts and in cylinder packing renewals, and no difficulty has been experienced from carbonization.

Several cases were mentioned where comparisons between engines equipped with by-pass valves or relief valves and others unequipped have demonstrated the need for some such equipment. Without it cylinder packing, valve packing and rod packing all gave trouble while with it this trouble was eliminated and the life of the packing materially increased. The difficulty in lubricating the low pressure cylinders of locomotives when drifting was mentioned. Where using the drifting throttle it has been found that a reduced cut-off is necessary to permit the building up of sufficient pressure in the receiver to properly carry the lubricant into the low pressure cylinders.

The drifting throttle was the subject of much of the discussion. In fast passenger service on the New York Central it is the practise to ease off the throttle in making stops, but not to close it until the speed has been reduced to 15 miles an hour. Many back end main rod failures are attributed to the severe pounding resulting from a full closure of the throttle at high speed. Other members also advocated the drifting of all locomotives with steam admission, but this practice was objected to by others because of the difficulty of properly regulating it. In closing the discussion, J. B. Heyburn, chairman of the committee, commenting on the practice of drifting with steam admitted through the main throttle, did not question the ability of some men to get good results, but considered that the average man is not sufficiently skillful to do so. He therefore advocated the development of some form of drifting valve which would operate automatically.

WHAT ARE THE MOST SUITABLE DRAFT APPLIANCES?

The most suitable draft appliance is that which will produce the required draft with least back pressure under the varying conditions of locomotive operation. That such draft be developed uniformly is greatly to be desired in order that cinder losses may be reduced and the mixture and chemical union of gases in the fire-box improved, and also because the peaks or maximum efforts of intermittent draft are largely responsible for the plugging of flues; the loss in superheat caused by obstruction to the flow of gases in the superheater tubes frequently being as high as 32 per cent.

Development of draft apparatus which gives promise of approximately complying with these requirements has been under way during the past year or two and should be encouraged; but for the immediate need we must confine our efforts to the fixtures at hand or easily obtainable. The required draft in many instances is less than that which will develop the maximum evaporation. Engines in switching service or regularly in light work of other nature may often be run successfully with draft appliances which demand less back pressure than would be required if the same engines were engaged in more severe continuous work.

While the cinder losses will average approximately 6 per cent of the fuel burned, these losses frequently increase to from 18 per cent to 23 per cent during the period of maximum effort. However, the amount of fuel used per unit of work done decreases rapidly and consistently as the tonnage per train increases toward a reasonable maximum. Therefore, in general, the draft appliance should be so constructed as to provide for satisfactory performance at maximum capacity of each locomotive, and fortunately such arrangement will be found as generally satisfactory as is possible with present apparatus during periods of lighter work.

Section III Committee Report

Results of a series of nozzle tests were recorded briefly in the report of the Committee on Fuel Economy and Smoke Prevention at the June convention of the American Railroad Association, Section III, Mechanical.*

This committee summarized the results of these tests and its conclusions as follows:

"They indicate that under the conditions peculiar to this test with a nozzle having four internal projections it was possible to obtain a higher equivalent evaporation per hour with less back pressure than with a circular or rectangular nozzle having approximately the same net area.

"Your committee does not consider the information now available sufficiently complete to justify positive conclusions as to the most efficient shape of nozzle, and is only in position to report that the circular form of nozzle does not result in the highest vacuum and the least back pressure. As to what form will produce those conditions it is impossible to say without an extended investigation involving a long series of test plant observations.

"It seems evident, however, that all preconceived ideas of exhaust jet action must be revised to agree with the apparent fact that the best results will be obtained when the jet contour is interrupted, as is the case both with the internal projection nozzle and with the one having one axis longer than the other."

The increased draft obtainable by use of the four internal projection nozzle is said to be due to the increase in gas entraining capacity which results from breaking up the continuity of outside of exhaust steam column, thus increasing the surface of the steam jet with which the smoke-box gases may come in contact and promoting the intermingling of these gases with the steam jet.

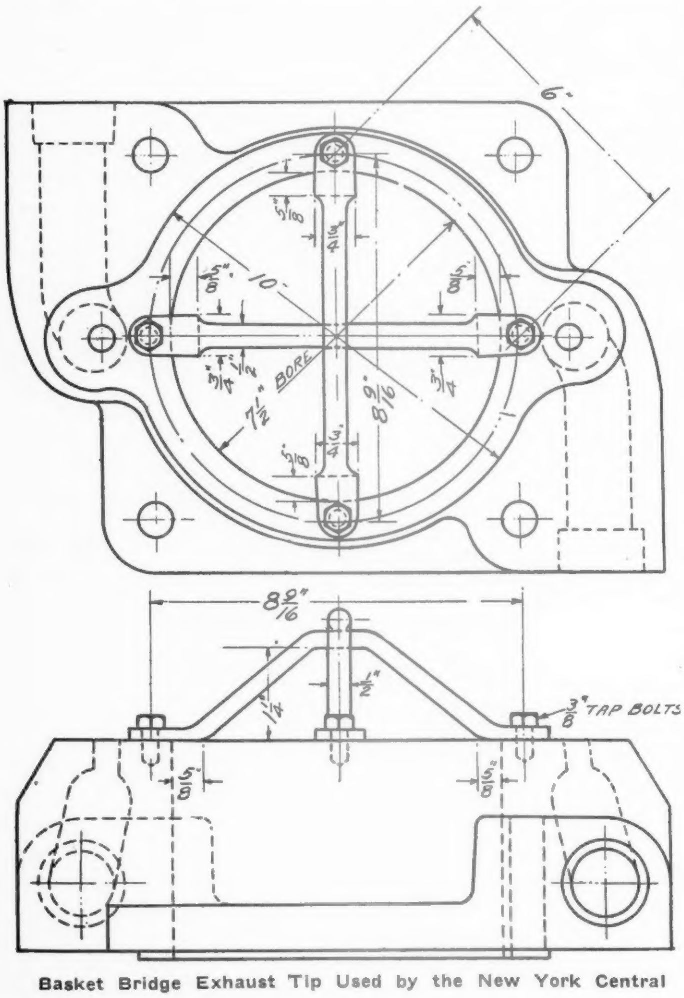
Indicator cards taken during tests with the internal projection nozzle illustrate clearly that at low temperature the steam does not flow so rapidly as at higher superheat, that with low superheat there is higher back pressure and also a lower initial cylinder pressure even when the steam chest pressure is higher for low superheat than for high superheat. This increase in rapidity of flow due to superheat accounts for the "snappier" exhaust of the superheated locomotive; and as the amount of draft depends, among other conditions, on the length as well as the speed of exhaust jet, it might appear that a reduction of nozzle size should

*See the *Daily Railway Age* for June 11, 1920, page 1705.

accompany the superheating of a locomotive. However, this has not been found necessary in many instances and a conclusion that draft appliance details, including size of nozzle tip, when most suitable for locomotive using saturated steam, should not be changed when superheating apparatus is installed, is sustained by carefully conducted tests at the Pennsylvania Railroad testing plant at Altoona. We are justified, therefore, in using smaller nozzles with superheated steam than were most suitable for saturated steam only as a last resort.

The Basket Bridge Nozzle

Attention is also invited to the nozzle tip arrangement in use on a large number of New York Central locomotives which consists of the usual circular nozzle provided with a so-called "basket bridge," consisting of two splitters set at right angles with each other with the point of intersection directly over the center of nozzle, the splitters being arched



Basket Bridge Exhaust Tip Used by the New York Central

to 1¼ in. above the tip at the center. This device is giving very satisfactory service, the use of splitters so arranged having made it possible to increase the effective nozzle opening very materially above the required opening of the plain circular nozzle tip. Engines so equipped give splendid performance, both from capacity and fuel economy standpoints.

N. & W. Tests

In the June, July and August, 1918, issues of the *Railway Mechanical Engineer,* there appears a series of articles written by H. W. Coddington, engineer of tests of the Norfolk & Western, giving accurate and valuable information obtained from extensive tests under most carefully arranged conditions in road service. The experiments indicated clearly the possibilities for improvement in draft and locomotive performance by variation from the standard practices and appliances which have been in use for years. These tests also show conclusively that by increasing the external surface of the exhaust column, thus affording greater opportunities for contact of this steam column with the front end gases, that material improvement in draft and locomotive performance can be obtained.

The results recorded were obtained during tests with Norfolk & Western engine No. 100, class "K-1" 4-8-2 type. The original nozzle was 7 in. in diameter with 9⅜-in. splitter, and a free area of 35.86 sq. in., 18-in. stack and 26½-in. inside extension. As a result of experiments the stack was changed to one of 24-in. in diameter, with 26½-in. extension and 14-in. diameter annular waffle iron nozzle, with effective area of 49.35 sq. in. The steaming capacity was improved; exhaust pressure with the circular nozzle and splitter was 10.94 lb., with the waffle iron nozzle, 4.54 lb.; front end draft with the circular nozzle and splitter was 8.91 and with the waffle iron nozzle 8.63 in. of water, and the locomotive under the decrease in back pressure developed approximately 140 additional horsepower. Using the very conservative figure of 5½ lb. of coal per indicated horsepower per hour, this shows a possible saving of 770 lb. of coal per hour, while the locomotive is working at the rate maintained during the test runs.

Mr. Coddington very recently advised us that the front end arrangement described has been applied to the U. S. R. A. Mountain type locomotives, N. & W., class K-2, with as great resultant benefit as was observed in the K-1 class.

The Theory of Draft Action

Supplementing the conclusions on this subject, as stated by the Committee on Fuel Economy and Smoke Prevention, it seems that any change from the plain circular periphery of the steam jet increases its efficiency in producing draft; one reason for this is that a circle being the shortest possible boundary for any given area, if the cross section of the steam column between the nozzle and stack is circular, the column will have less surface area than it would have if its cross section was any other form. The gas "entrainment" theory is supported by all investigation. However, during the Norfolk & Western tests it was found that the best results were obtained when the exhaust steam column struck the sides of the stack 38 in. or 70 per cent of the length of stack, including the extension, below its top. Every traveling engineer knows that when the exhaust does not essentially fill the stack at the top there is a down draft at the locality not filled and therefore both the so-called "entrainment" and piston action assumptions must be considered when studying this most interesting and important matter.

The expulsion of air and gases from the smoke-box by means of a steam jet directed up the stack is accomplished by the steam jet, either blower or exhaust, forcing (not pulling) air and gases through the stack. A steady flow of steam out the exhaust nozzle or blower will produce draft because the outside surface of the expanding column is broken up irregularly into numerous sections or jets which engulf within the column as a whole and pocket against the sides of stack many small portions of the gases in smoke-box or stack, and thus by pushing innumerable small quantities of smoke-box gases out the stack in this manner reduce the smoke-box pressure.

The Multiple Nozzle and Stack

It appears that the Norfolk & Western has gone farther in the right direction than the other experimenters, at least in so far as applications in service are concerned, but in stack investigation they varied only the diameter of the stack and extension and the length of stack extension inside the smoke-box, and they got best results from the longest extension used. Developments made by William Elmer of the Pennsylvania are therefore of special interest. He found by a

long series of tests that best results in draft production, by means of a steam jet issuing from a circular nozzle tip, were obtained when the diameter of conduit or stack was 3.1 times the diameter of nozzle and when the length of conduit or stack is from five to six times its diameter and when the jet first filled the conduit at about the center of the conduit. Obviously, it is impracticable to provide a modern locomotive with a stack from 10 to 12 ft. long, but by exhausting through several nozzle tips suitably placed below a stack containing a nest of conduits he was able to accomplish a working basis for the desired dimensions within clearance limits and to increase the effective nozzle opening 30 per cent as compared with that of the largest single circular nozzle which it had been possible to use. The multiple nozzle and stack also materially increase the draft.

It does not require exhaustive thought to determine that a stack can be too short and that a stack can be so long that friction of gases and steam within it will detract from the benefits derived by having just enough stack length. The multiple nozzle and stack design provides a method for equipping modern locomotives with stacks of sufficient diameter and length and it also provides for an extensive increase in the surface of the exhaust steam column between the nozzle tip and stack as well as for a very material increase in effective nozzle opening.

Some most interesting experiments conducted by the mechanical department of the Big Four during the past year indicate the advisability of maintaining the same average exhaust pressure while a locomotive is operating at maximum capacity during the entire range of speeds, and they have equipped at least one locomotive with apparatus which automatically adjusts the cut-off so as to maintain a predetermined exhaust pressure at all speeds. It is not the intention to discuss this invention, but we urge the installation of back pressure gages on all road locomotives, as knowledge of this pressure will not only aid greatly in improving draft conditions and apparatus, but will enable the engineers to operate locomotives more efficiently.

Distribution of Draft Through the Grates

Even a most efficiently developed draft in the smoke-box will only partially obviate some of the present losses and inefficiency, unless that draft is most advantageously distributed throughout the fire-bed. Use of the so-called checkered arch appeared to be a move in the right direction, but difficulties have arisen in connection with its general use. The standard arch, as usually applied, causes the draft to be applied most severely through the back grates and, to avoid the ill effects of excess air through this section of the fire-bed, firemen have resorted to excessively heavy firing on the back gates. We have decried such practice as wasteful—perhaps without entire justification under the existing unequal distribution of draft.

Draft deflector plates below the grates or variations in air inlet openings through the grates so as to equalize or properly distribute the draft through the fire, seem to be required when the standard arch is used, but because of the difficulties which would be encountered in following either of these suggestions, suitable changes in the location of arch bricks or the reduction of air openings through the rear grates are recommended—preferably the former, for we fully appreciate that the best performance demands the maximum possible opportunity for air to pass through the grates.

The report was signed by H. C. Woodbridge (Loco. Stoker Co.), chairman; W. G. Tawse (Loco. Superheater Co.), W. M. Cooper (Grand Trunk), H. L. Harvey (C. & N. W.), and T. L. Kenney (Big Four).

Discussion

Several members were disposed to question the statement in the report made in referring to the checkered arch, that the standard arch is the cause of the apparently heavier draft at the back end of the grates, this being explained as due to the tendency for a heavier fire to accumulate at the front end of sloping grates and to the openings at the rear ends through which the grate rigging passes which provide for greater air admission under the rear end of the grate than at other portions. Some difference of opinion was expressed as to the advantages of the checkered arch, although in one case where comparative tests have been made and the coal measured, the fuel consumption has been found to be less with the checkered arch than with the standard arch. The former has also proved advantageous in reducing smoke on switch engines in terminals. The statement was made in the discussion that the basket bridge used on the New York Central in one case made possible an increase in the size of nozzle opening from 5½ in. to 6⅝ in. and that wherever it has been used it has resulted in a reduction in fuel consumption.

The discussion showed a feeling among many of the members that an exhaustive investigation of front end designs in which all factors should be taken into consideration, was very much needed.

In closing the discussion Mr. Woodbridge laid stress on the value of the installation of a back pressure gage in the cab, connected through branch pipes to the exhaust passages of the cylinders. This has been found of value in comparing the draft efficiency of different engines and in providing the engineman with a check both on draft conditions and on his handling of the engine.

THE NICHOLSON THERMIC SYPHON

BY HARRY CLEWER
Fuel Supervisor, Chicago, Rock Island & Pacific

The first application of the Nicholson-Thermic Syphon equipment to a locomotive was made more than two years ago on the Chicago, Milwaukee & St. Paul; this road since then has equipped four more locomotives.

About sixteen months ago the Chicago, Rock Island & Pacific equipped two locomotives, one superheated and one non-superheated, after which an extended and thorough test of this equipment was conducted, comparing these engines with others of the same class but without the syphons.

Test results and subsequent developments in service were of such a favorable nature that a program has been established of equipping ten engines a month in the shops. In addition to this, thirty-five new Mikado, Santa Fe and Mountain type locomotives now building will be equipped with syphons. This will make a total of 75 locomotives equipped.

Comparative Summary of Tests of Superheated and Saturated Locomotives, With and Without Nicholson Thermic Syphons.

Locomotive number Description	2057 Saturated, arch tubes and arch	2062 Saturated, syphons and arch	2021 Superheated, arch tubes and arch	2039 Superheated, syphons and arch
Pounds coal per locomotive mile	262	220	195	166
Pounds combustible per locomotive mile	206	168	150	128
Pounds coal per 1,000 gross ton miles, adjusted	129.3	108.1	80	68.7
Pounds combustible per 1,000 gross ton miles, adjusted	101.7	82.0	62.8	52.8
Equivalent evaporation per lb., dry coal	6.84	7.62	8.06	9.14
Equivalent evaporation per lb., combustible	7.85	8.94	9.33	10.71
Boiler efficiency—percentage	56.26	63.20	65.34	74.18

It is possible to increase fire-box heating surface from 10 per cent to 40 per cent, depending upon the number and size of syphons used. One, two and three are used, depending upon the width of the box. The syphons form two to four combustion chambers in the hottest part of the fire. This leads to a much better mixture of the liberated gases and air, thus aiding complete combustion. The syphon heating surface is in a position to "see" the fuel bed and flame,

so the transfer and heat to the syphon by radiation is high.

Intake channels enter the neck of the syphon at the throat sheet and extend along the barrel of the boiler nearly to the boiler check. They are simply inverted troughs capable of delivering to the syphon all of the water which will be discharged through the crown sheet opening.

The Rock Island tests showed that the two-syphon equipment on a consolidation locomotive increased the evaporation 14 per cent per pound of coal. A summary of the tests is given in the table and all indications on locomotives equipped since the tests were conducted, verify the test results.

The syphon equipment does not disturb the water level in the water glass. It was noticeable during the tests referred to that the water in the glass was very quiet.

The intake channels do not clog and the scale formation is no greater in the syphon than on the sides and crown sheets. Well located washout plugs make it possible to wash the syphons thoroughly.

Next Year's Officers

The following officers were elected to serve for the coming year: President, W. E. Preston (Sou.); first vice-president, J. H. DeSalis (N. Y. C.); second vice-president, F. Kerby (B. & O.); third vice-president, E. H. Howley (Erie); fourth vice-president, W. J. Fee (Grand Trunk); fifth vice-president, J. N. Clark (Sou. Pac.), and treasurer, David Meadows (M. C.). The following are the new members of the executive committee: J. D. Heyburn (St. L.-S. F.); J. E. Russell (Sou.), and V. C. Randolph (Erie).

Government Tests Of Water Indicating Devices

Report of Final Tests and Recommendations Submitted by The Bureau of Locomotive Inspection*

For the purpose of determining, if possible, the general outline of the flow of water which evidently existed at the back head, when high evaporation was taking place, tests were made on one of the U. S. Railroad Administration standardized 2-10-2 type locomotives, equipped with five arch tubes and brick arch, extending to within 51 in. of the door sheet; fired with duplex stoker and using bituminous coal for fuel. The test apparatus used in these tests is of the boiler. It was found during these tests that with the top connection to the water column connected at its original position the column would entirely fill when 4 in. to 5 in. of water was reached in the column glass. When changing from this connection to the highest point on the back head, the water would immediately recede to 4 in., but when changing from one connection to the other on the highest part of the boiler the readings were not affected, which in-

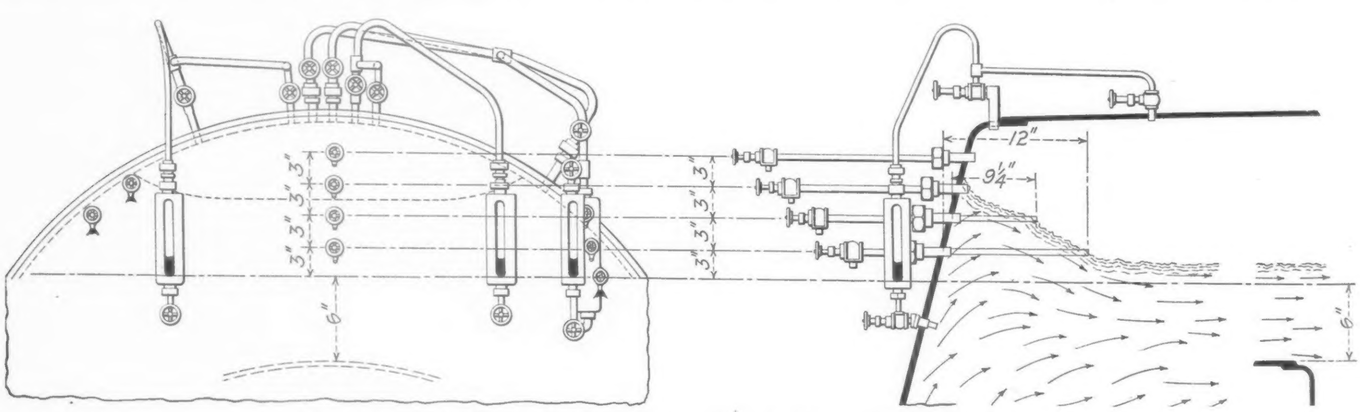


Fig. 3—Water Indicating Devices Used in Fourth Series of Tests

shown by Fig. 3; the sliding tubes illustrated were graduated so that correct readings could be taken.

Fourth Series of Tests

During two round trips many readings were taken while the locomotive was in operation. It will be noted, by referring to Fig. 3, that with 2 in. of water showing in all glasses and one gage of water in the column, the gage cocks applied on the left side of the boiler head in the usual manner indicated full water, while No. 1 tube indicated strong flutter at a 12-inch adjustment, No. 2 tube indicated a strong flutter at a 9¼-inch adjustment, and No. 3 tube showed an occasional flutter at the back head, showing a rise of water at the back head of approximately 9 in. above that being registered by the water glasses or existing further ahead over the crown sheet.

The dotted line in Fig. 3 indicates what we believe to be the general outline assumed by the water where it reaches a greater height on each side than at the vertical center line

dicated that dry steam was being obtained both at the back knuckle and further ahead, which was, no doubt, due to the increased dry steam space in the back end of this boiler and the exceedingly good water used in this district.

Fifth Series of Tests

To further determine the approximate outline and proportions of the water conditions existing at the back boiler head, while the locomotive is being operated with heavy throttle, or when steam is being rapidly generated and simultaneously escaping from the boiler, tests were made with appliances shown by Fig. 4, covering a distance of 808 miles, in bad-water districts, on approximately level track and while handling regular tonnage.

The locomotive on which these tests were made was of the heavy 2-8-2 type, equipped with superheater and Duplex stoker, using bituminous coal for fuel. The boiler had a sloping back head, with firebox equipped with brick arch supported by four 3-inch arch tubes, the brick arch extending to within 52 in. of the door sheet and 30 in. of the crown sheet.

The apparatus shown by Fig. 4 consisted of four gage

*The preceding portion of this account of tests recently conducted by the Bureau of Locomotive Inspection of the Interstate Commerce Commission was published in the September issue of the *Railway Mechanical Engineer*.

cocks applied directly in the back head near the knuckle, one water column to which three gage cocks and one water glass were attached, one water glass with a 9-inch reading, standard application, with both top and bottom cocks entering boiler back head direct, one water glass applied for experimental purposes with the bottom cock entering the boiler head on back knuckle and one entering 13 in. boiler head on back knuckle and one entering 13 inches ahead of the back knuckle, and four exploration tubes or sliding gage cocks.

Fig. 4 shows a side elevation of these exploration tubes or sliding gage cocks entering the back head parallel to the horizontal axis of the boiler through suitable stuffing boxes, with a vertical pitch of 3½ in., giving a total vertical reading of 10½ in. with a horizontal adjustment of 24 in. Gradations were marked on these tubes so that accurate readings could be taken and recorded. The lower one of these tubes entered the boiler head on a level with No. 2 gage cock. The lowest reading of all water glasses and gage cocks was 4⅝ in. above the highest point of the crown sheet.

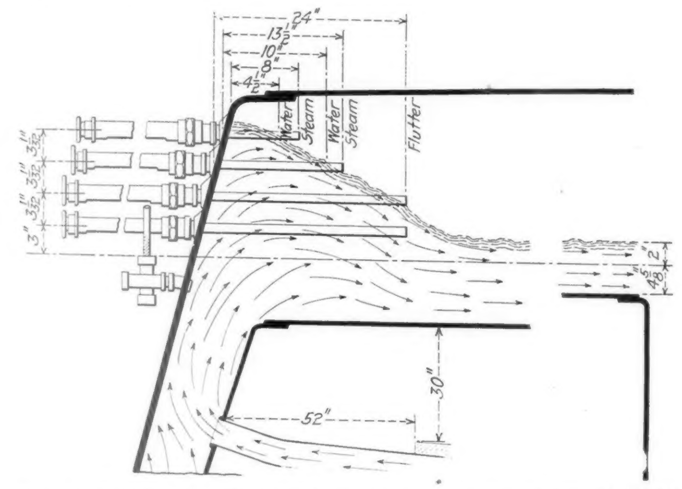


Fig. 4—Water Indicating Devices Used in Fifth Series of Tests

It will be noted from Fig. 4 that while tube Nc 1 was submerged, tube No. 2 showed a flutter of steam and water at an adjustment of 24 in.; tube No. 3 showed water at an adjustment of 10 in and steam at 13½ in.; tube No. 4 showed water at an adjustment of 4½ in. and steam at 8 in. These readings were taken while the experimental water glass and water glass attached to the water column registered 2 in. of water, and the gage cocks attached to the water column showed one gage, while the four gage cocks applied in the back head registered full.

The water in the territory where these tests were made is very light and foams badly when compound is not used. About 110 readings were taken with these tubes or sliding gage cocks and other appurtenances used to register the water level. It is impossible to outline this flow of water accurately, as it changes with the operating conditions and the condition of the water in the boiler; but it is believed that this serves to illustrate the general condition which prevails to a greater or less extent in all locomotive boilers, especially those equipped with brick arch and arch tubes, while the locomotive is working heavy throttle or steam is rapidly escaping from the boiler.

It was found that approximately the same conditions were disclosed as those developed in other tests, except that the outline of water reached a higher elevation and greater proportions at the back head than those illustrated by Fig. 3, which is, no doubt, due to the extremely good water used for locomotive purposes in the district where the previous tests were made.

The readings of the water column and experimental water glass could not be varied when changing from one connection to the other, as was the case in other tests, which we believe was due to the increased steam space in the back end of this boiler; and while the roll of water up the back head reached at times an approximate height of 12in. to 13 in. above the general water level in the boiler, it did not apparently reach the top connection to these appliances in the back head knuckle.

When foaming very badly, there was slight agitation in the experimental glass when connected in the back knuckle, and occasional bubbles in the glass, but not sufficient to attract serious attention. This agitation was entirely absent when the top connection was made ahead of the back knuckle. With 1 in. of water, or less, the water in the standard glass registered practically the same height as the other two glasses. With 2 in. to 2½ in. of water in the glass, when water was foaming, the water in the standard glass rose 2 in. to 3 in. higher, and there was much agitation and many bubbles in it, while the column glass and the experimental glass connected ahead showed no agitation whatever. With 3 in. or more of water in the standard glass and the water foaming badly, the standard glass would fill, and it was impossible to tell the actual height of water in the boiler by that device without closing the throttle, while the experimental glass and the glass attached to the column continued to register 3 in. or more of water, and the top gage cock, attached to the column, would indicate dry steam when opened in the usual way, and the four gage cocks applied directly in the boiler would register full water.

Observations Made with Light in Boiler

Tests were made on a comparatively small locomotive, used in switching service, equipped with a wagon-top, radial-stayed boiler, having narrow OG firebox and vertical back head, the diameter of the largest course being 59 in. The special feature which should be borne in mind is that no arch or arch tubes were used in this boiler and that the back head was vertical.

The water-indicating devices consisted of three gage cocks spaced 3 in. apart and applied directly in the right knuckle of the back boiler head, with a vertical reading of 6 in., and one reflex water glass with a clear reading of 7 in., and with top and bottom connections entering the boiler head direct on the vertical part 5 in. to the right of the center line. The lowest reading of the gage cocks and water glass was 3 in. above the highest part of the crown sheet.

So that the action of the water could be observed, a glass tube was inserted in the top of the wrapper sheet which permitted the use of an electric light inside the boiler, which clearly illuminated the steam space over the crown sheet. Five bullseye sight glasses were applied over the back end of crown sheet, two over the front of crown sheet and three in the vertical back head, so that the action of the water in this part of the boiler could be seen while under steam pressure. The arrangement of these appliances is illustrated by Fig. 5.

Both main rods were disconnected, cross heads blocked at end of stroke and valve stems disconnected and so placed that steam was discharged through the exhaust nozzle and stack, creating a forced draft on the fire, representing as nearly operating conditions as possible.

When the throttle was closed and no steam escaping from the boiler, the surface of the water was approximately level, with a distinct circulation noted from back to front and from the sides toward the center of the crown sheet. When the safety valves lifted, the water rose with fountain effect, around the edges of the firebox, from 1 in. to 2 in., and the circulation was materially increased.

When the throttle was opened and steam was being generated and escaping from the boiler in greater volume, the level of water throughout the boiler was seen to rise 1 in. to

1½ in., which rise was registered by the water glass, and a marked flow of water, with fountain effect, was observed rising around the firebox at the back head and wrapper sheets, reaching a height above that over the remaining portion of the crown sheet of approximately 2 in. to 4 in., in proportion to the amount of steam being generated and simultaneously escaping from the boiler.

The important feature to be noted is that this height of

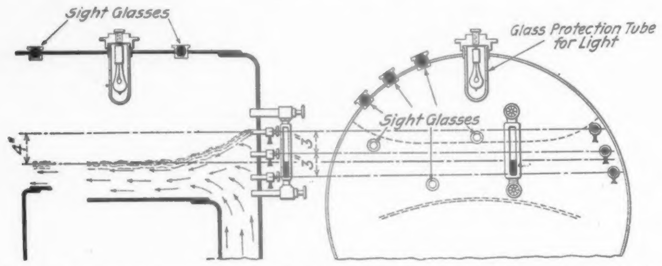


Fig. 5—Arrangement of Light in Boiler to Determine Water Conditions

water, as seen at the back head, was approximately 4 in. at its maximum, and was registered by the gage cocks, while at the same time it could be seen that the water glass was registering the level further ahead over the crown sheet.

Among the interesting features observed were the size of the steam bubbles which were approximately ¼ in. to ⅜ in. in diameter, and the rapidity with which they were seen to rise to the surface and explode. The size and number of these steam bubbles, which were seen rapidly rising next to the back head, explain one of the physical reasons for the increased height of water around the crown sheet and the rapid circulation attained.

These observations establish beyond question that when steam is being generated and escaping there is an upward movement of water at the back head of the locomotive boiler which carries it above that further ahead over the crown sheet, and that the gage cocks, when applied directly in the boiler, register this rise of water and do not indicate the level further ahead, while the water glass registers the level of water further ahead and not the fountain of water at the back head.

Since a difference of 4 in. was observed between the height of water at the back head and that further ahead in this boiler, which had a vertical back head and OG type firebox and was not equipped with brick arch or arch tubes, there can be little question but that in the modern locomotive boiler, which has a sloping back head and is equipped with brick arch and arch tubes, which greatly accelerates the movement of water in this part of the boiler, due to the rapid circulation through the arch tubes and the deflection of heat against the door sheet and back end of crown sheet by the brick arch, this difference between the height of the water at the back head and further ahead over the crown sheet must be materially increased.

General Observations

The feed water which enters near the front end is much lower in temperature than that in the boiler, which, due to its density and weight, naturally lowers and moves toward the firebox sheets where the greatest evaporation takes place. As the water is heated it rises, due to its decreased weight, influenced by the steam bubbles rising to the surface where they explode. This circulation causes a movement of water from front to back in the lower portion of the boiler, and upward around the firebox, and from back to front in the upper portion. This circulation unquestionably takes place with sufficient rapidity to carry the water in the boiler around the firebox sheets above the general water level, due to the limited space in the water legs, where the greatest amount of heat is applied.

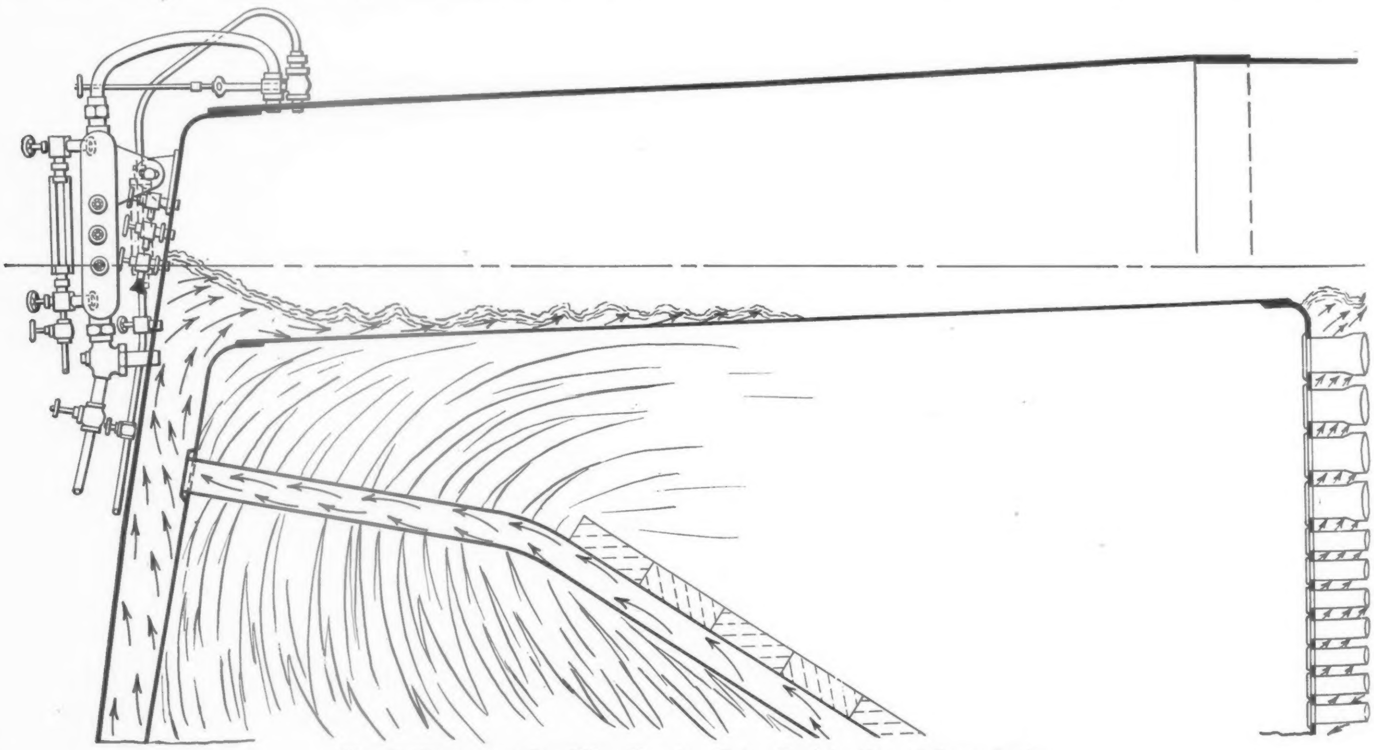


Fig. 6—Dangerous Condition Due to False Registration of Gage Cocks

Fig. 6 illustrates a condition which may exist where the water glass registration is ignored and the gage cocks applied in the boiler are depended upon to register the correct level. Since practically all enginemen have been taught to rely on the gage cocks in preference to the water glass, this is an especially unsafe condition, and is, no doubt, the cause of many damaged crown sheets the reason for which has not been determined.

It is recognized that the volume of water in the boiler increases in proportion to the amount of steam being generated and in the same ratio that the steam bubbles below the surface are formed and expanded, the volume of which depends to a very considerable extent upon the purity of

the water in the boiler and its ability to readily release the steam being generated, consequently increasing the height of water in the same proportion, which height is registered by the water glass.

Since it has been established that gage cocks screwed directly in the boiler do not correctly indicate the general water level, the question arises as to what would be a proper appliance. After careful investigation and tests, it is believed that Fig. 7 illustrates a water column that will afford the safest and most practicable method yet disclosed for accurately indicating the general water level in the boiler under all conditions of service.

Recommended Practice

This arrangement has been recommended by this Bureau and was adopted as recommended practice by the Committee on Standards, of the U. S. Railroad Administration, at its February, 1920, meeting. To this water column three gage cocks and one water glass are shown attached, one water glass applied in the usual manner on the left side of boiler head for the purpose of forming a double check of the height of water over the crown sheet and to broaden the view from different parts of the cab.

In constructing and applying the water column, the ratio of openings between top and bottom connections, as indicated by Fig. 7, should be retained, and the bottom connection screwed into the boiler far enough to pass all obstructions which may be immediately above them. It was illustrated in the fifth series of tests that when the bottom connection to the column entered the boiler head one inch past flush, and directly under a "T" iron, it caused the water to rise one inch in the column glass, but when extended past the "T" iron, the readings in all glasses corresponded.

The larger connection to the top of the column, and restricted openings in the gage cocks, which should be not more than ¼ in. in diameter, are suggested for the purpose of preventing the water from being raised when the gage cock is opened wide, the object being to compensate for the lowering pressure in the column through the larger top connection, the area of the smallest opening of which should not be less than 1½ in. copper pipe, so preferably larger.

Very recent tests indicate that to avoid the possibility of inaccurate readings, due to raising the water in the column when the gage cocks are opened excessively wide, the inside diameter of the column may be made 3½ in. and that of the top connection 2 in. Experiments with column and steam pipe of these dimensions and the ¾-in. opening in the connection to the boiler at the bottom showed that the water in the column glass could not be raised, by opening the gage cock, to exceed ¼ in., regardless of the amount or the length of time the gage cocks were open.

It is recommended that the bottom water glass cock and bottom connection to the water column enter the boiler horizontally, and that the water column and water glasses should stand vertical.

Steam-pipe connections to water columns and water glasses should be made as short as possible, so as to obtain a supply of dry steam at all times, and so arranged as to thoroughly drain and be free from short bends or any possibility of sags or traps. It has been definitely established that where traps or sags that will retain the water of condensation are permitted in the top connection to water glasses or water columns, the reading of the water is materially affected, causing a higher level to be indicated.

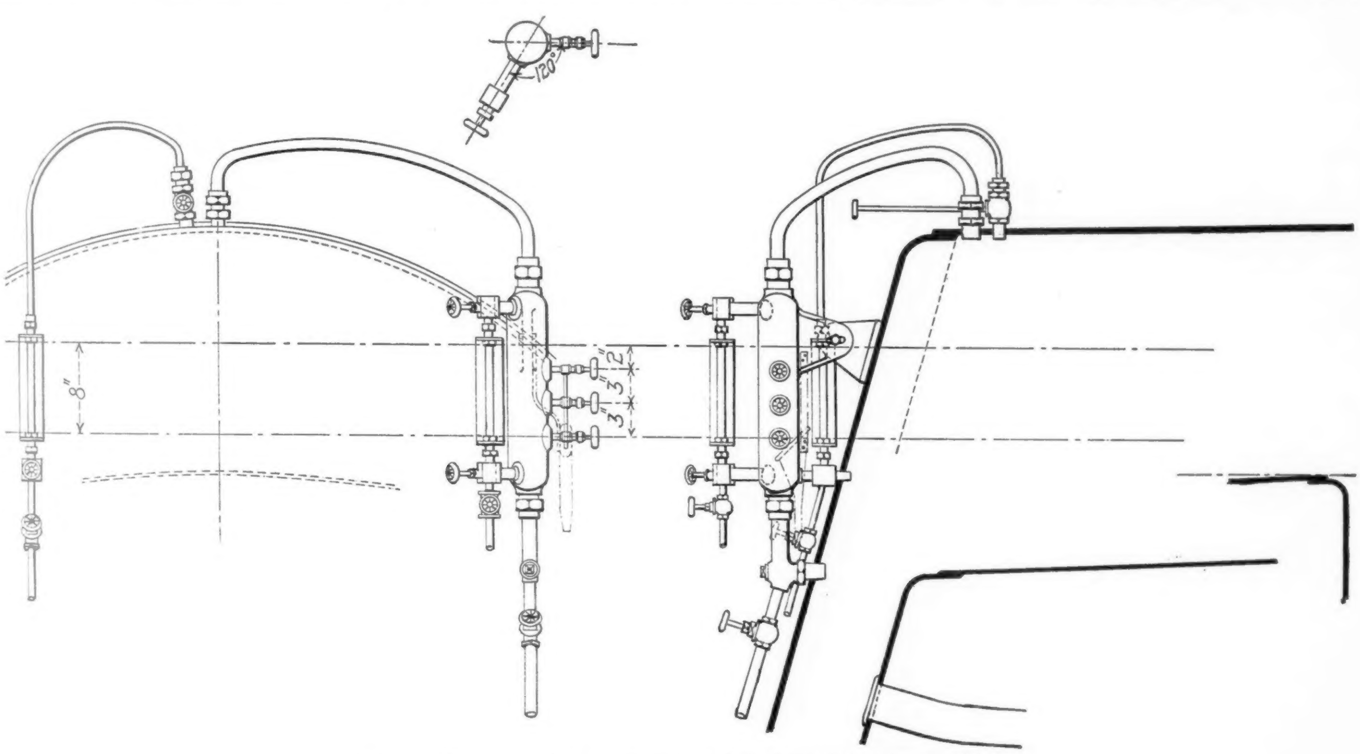


Fig. 7—Recommended Arrangement of Water Indicating Devices

It should be borne in mind that when water glasses are in proper condition to correctly register the water in the boiler, the water is never at rest while under pressure, and that when the water becomes slow or sluggish of movement or in agitation, it indicates an improper condition that should be immediately corrected. Such conditions are usually caused by restriction in the openings in the fixtures, sags or traps in the steam-pipe connection, or the top connection made so as to allow water to enter, and sometimes by bottom connection being improperly located so as to cause steam bubbles to enter.

The water-indicating appliances are among the most important devices on the locomotive, from the viewpoint of safety as well as economy; therefore, every effort should be made to see that they are so constructed, applied and maintained as to properly perform their function under all conditions of service, and so that the enginemen operating the locomotive may have the widest and easiest possible view from their usual and proper positions in the cab.

General Foremen Hold Annual Meeting

Discussion on Methods of Reducing Cost of Equipment Repairs Covered a Wide Range of Subjects

THE problem of selecting and training foremen, the handling of labor, the need for adequate machinery and facilities and the scope of the fusion welding processes, in their bearing on reduction in the cost of repairs to cars and locomotives, were the subjects discussed with the keenest interest by the members of the International Railway General Foreman's Association in attendance at the sixteenth annual convention.

The convention was held at the Hotel Sherman, Chicago, September 8 to 10, inclusive, with President W. T. Gale (C. & N. W.) in the chair. Following the customary formal exercises at the opening session, President Gale delivered his address. An abstract of his remarks follows:

President Gale's Address

Much might be said as to ways in which improvements in railway transportation may be made. Government control of the railroads in the United States has now ceased to exist, and it is natural that the railroad companies should desire to return to improved pre-war conditions. There is a demand for earnest effort at increasing the production of essentials and the markets of the world are ready for our country's productions. As foremen in railroad shops we must do our full part in helping to get results. It may be considered a patriotic duty to serve the country in providing efficient and economical transportation for its citizens and products.

In the supervision of employees, foremen can get the best results by dealing kindly but firmly with all men under their charge. Foremen should not be led astray by any impressions of their personal importance, but must rather be filled with the spirit of fairness to all. The interest of their employers can best be served by a proper understanding not only of the materials which they must handle, but also by securing the effective co-operation of all employees under their supervision. The part of the program pertaining to the proper handling of labor should be fully discussed.

Address by Robert Quayle

Robert Quayle, general superintendent of motive power and machinery of the Chicago & North Western, addressed the association, dwelling particularly on the importance of the general foreman's job to the railroad and to the nation. He drew attention to the fact that the ton mile cost of moving freight on American roads is the lowest of any country in the world, Japan ranking next. But while our labor cost averages about $1,600 per man per year, Japan's is only $174, which is some indication of the efficiency of American methods and American railroad men. The part of the general foreman is particularly important in getting results in the mechanical department because of his close contact with all of the details, which in the aggregate must be properly handled to secure the final result desired.

Mr. Quayle said that railroad men are not wholly responsible for the unrest which has been such a potent factor in bringing about the comparatively low productivity of labor at the present time. Railway employees have been expecting increases in wages since before the war and have long been thinking and talking about little else. The recent wage increase, however, has satisfied most of the men. With the dissatisfaction removed the men are now ready to give thought to their work. Mr. Quayle stated that increased production must be obtained through the general foremen, who must exert a steady continuous pressure on the men to get back to pre-war conditions of output. In doing this, however, it must not be forgotten that they are men and they must be dealt with smilingly and with kindly feeling.

STANDARDIZATION OF ENGINE FAILURES AND TERMINAL DELAYS

The committee will not attempt to define what shall or shall not constitute an engine failure, believing that better conclusions can be arrived at after the question has been thoroughly discussed.

"Time cards do not provide for failures, so why have them? While it may be true that there are many failures, let us all try to avoid them if possible, and not make a standard of them, no matter how great or small they may be," says one master mechanic, in writing to the committee.

The following is the line of procedure followed by some roads when an engine failure occurs:

All information relative to the failure is secured from operating officers on division on which failure occurs. Mechanical officers at the division point secure all available information from the engineer, which is also supplemented by a written statement from the engineer.

If, in the opinion of the party receiving the statement from the engineer, the failure was due to improper handling of the locomotive by any member of the crew, the superintendent is requested to have an investigation made by road foreman. If the engineer contends that the failure was due to the engine, or if the work as reported was not properly performed at the terminal from which the engine was dispatched, the party in charge at that terminal is required to make a statement. The engine inspector is required to inspect all engines and check his inspection against the work report of the engineer. He is further required to know that this work was performed in a satisfactory manner before the engine leaves the terminal. The men performing the work are all questioned as to the manner in which the work was performed, and the decision is then made as to whether the work was satisfactorily completed.

In the event of the failure of the parts of a locomotive, the broken parts are collected and delivered to the mechanical engineer for his opinion as to whether the defect was caused by a flaw in the metal, overheating, lack of lubrication, etc. If caused by a flaw, steps are taken at once to secure a statement from the terminals between which the engine has been operating as to what has been observed by inspectors or reported by the engineer. If, in the opinion of the mechanical engineer, the defect was caused by improper construction, he will change the design.

In the event of a failure due to the engine not steaming, the quality of the coal is taken into consideration and the engine's front end, fire box and flues are thoroughly inspected. If flues are stopped up, it is evident that the terminal from which the engine was dispatched is at fault and corrective measures are taken. If failures are due to improper firing or mishandling of the engine, the corrective measures are taken through investigation by the road foreman of engines.

Train dispatchers make four copies of each engine failure report. The superintendent sends one copy to the general superintendent, one to the assistant mechanical superintendent, one to the road foreman of engines, and retains one copy. This report is checked against the engineer's report. If the road foreman of engines considers an engine failure unjustly charged, he writes the superintendent, giving his reasons, and if the superintendent finds that the failure has been charged without cause, he cancels it, using regular report blanks for that purpose and sending copies to the general superintendent, assistant mechanical superintendent and the road foreman of engines.

The following is the personal opinion of a railroad officer of high standing, as to what should be considered an engine failure:

"I do not consider that a break down of less than five minutes should be called a failure. Where there is a delay of five minutes or more and the engineer picks up the time that he has lost in fixing up the engine and arrives at the terminal with no loss of time, this should not be classed as failure. Where an engine has been in excessive duty on the road and the fire gets dirty so that it has to be cleaned in order to complete the trip, I do not consider this is an engine failure, but a transportation failure due to holding engine too long in service.

"Again, a man might frequently stop along the road when he notices a back end of the main rod heating, to ease up the keys, making a delay of probably five minutes, and starting up with his train again and picking up the lost time. This is done to avoid a failure, but in a great many cases it is classed as a failure. At times the train crew sets the brakes from the caboose, pulling a drawbar out of the back of the tank or breaking the drawbar between the engine and tank. This is classed as a failure, but it should not be.

"What should be classed as a failure is an engine failing through leaky tubes when put in excessive service, losing time on the train that she is on, or when any material breaks, being defective in itself or in the workmanship, and causing a delay to exceed five minutes; in fact, any defect that is due to the engine."


W. T. Gale—C. & N. W.
President


J. B. Wright—H. V.
1st Vice President


G. H. Logan—C. & N. W.
2nd Vice President


William Hall—C. & N. W.
Secretary-Treasurer

Meetings should be arranged at frequent intervals when engine and train performance can be discussed freely and wrong practices corrected. The mechanical department should be advised at the earliest possible moment as to what power may be required, thus giving them time to make necessary preparations.

The members of the committee were Wm. Hall (C. & N. W.), chairman; J. R. Harrington (M. K. & T.), M. H. Westbrook (G. T. W.), H. E. Venter (Sou. Pac.), and W. Mulcahy (B. & O.).

Discussion

From the variety of definitions as to what constitutes an engine failure which were given by those who took part in the discussion it seems evident that a direct comparison of engine failure records can scarcely be made on any two railroads in the country. Not only is this true but practices differ in many cases on different divisions of the same system. The desirability of uniformity in the definition of what constitutes an engine failure, particularly on the divisions of the same system, received considerable attention.

Where practices differ, comparisons lead to unjust criticism and have a demoralizing effect on the organization. On the other hand, where the practice is uniform and just comparisons can be made, a spirit of competition to see which division can make the best record may be readily developed. Some of the members felt that efforts should be made to develop a standard for application on all railroads in order that direct comparison might be made between different systems. The effect that different operating conditions should have in establishing the definition was touched on. On a train making local stops, where frequently opportunity is offered to look after the locomotive, a rule that delays be charged whether made up or not is entirely different in its effect than when applied to fast non-stop runs, where it may be necessary to stop the train in order that an adjustment may be made to prevent a complete engine failure later. By comparison, however, injustice is done if such a delay is charged against the engine when the time has been made up before reaching the terminal.

It was also suggested that engine failures should be charged against shop points rather than to divisions. The reason for this is that passenger runs frequently operate over the lines of two or more divisions, the intermediate divisions, however, having no jurisdiction over the power. To charge a failure under these conditions to the division on which it happens to occur leads to unjust comparisons and provides a record which is of no value as a guide to corrective measures.

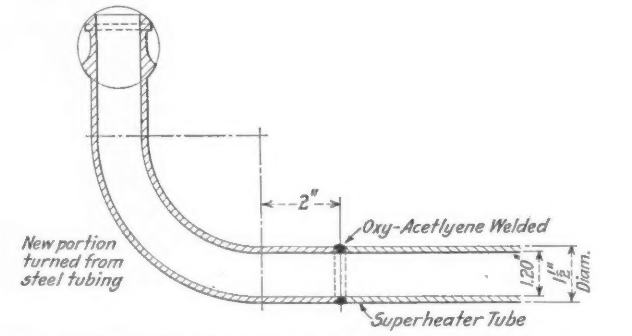
REPAIRING SUPERHEATER UNITS

Superheater units become worn at the front end between the bends and the ball joints. After considerable study and trial, it was found that the best method of repair is first to determine if unit is worn through to cause a failure, or so that they will not last until another shopping. If they pass this inspection, then apply a hydrostatic test of cold water up to 400 lb. While under this pressure the inspector should hammer test parts which show corrosion, especially around the return bend. If the return bends leak, and are worn too badly, they can be repaired by acetylene welding. If worn, there are two ways to repair them economically.

On the old style units the tubes can be cut off with acetylene next to the bend, rethreaded and new bends applied. The new units should be cut off at the return bend with acetylene on an angle of 45 deg., and then by the aid of two air cylinders, with the jaws facing each other, press the ends of the unit, heated to a cherry red, together to form a bend. Then weld the tubes together, using plenty of material to reinforce them on the flat surface and on the end of the bend. After this is done, again apply 400 lb. hydrostatic pressure and hammer test.

To repair the ball joint ends of units, they should be cut off back of the bend, say five to eight inches, with acetylene gas and then belled out to half the thickness of the tube, back 1⅝ in. To make the new ends, the balls are forged on each end of a piece of tubing. This is done in two operations of the forging machine. After being forged the ball joint is turned on a turret lathe and the tube is cut to whatever length is desired, the end being turned to fit the ball end of the tube. These new ends can be made 50 or 100 at a time, machined, ready to apply, and can be distributed to roundhouses or other than main shops which will save considerable time in getting power into service. After the new end is ready, it can be welded by acetylene in a few minutes. The 400 lb. hydrostatic pressure should then be applied to test the unit. After unit is tested, band should be applied and spot welded on each side by the electric or acetylene process to keep the band from slipping. This need not be over ⅜ in. in diameter and ⅛ in. high.

To get the best results in reapplying superheater units to header, the ball joints should be thoroughly cleaned and polished with emery cloth. The joint should then be tried with a standard gage, and if found to be out, should be ground with a mixture of oil and cut steel, using a soft metal grinding form and a small air motor. If joints are badly damaged, they should be trued up with a milling cutter and then ground with oil and cut steel. The joints on the header casting should be thoroughly inspected, and if found to need machining a milling tool opposite to the one used on ball joint should be used, and then ground with oil and cut steel, using a form the same shape as the milling tool. Slots in the superheater header should be carefully inspected to see that they are free from sand or scale and have a square surface, and that the bolt heads are square, so that there will be no chance of the bolts slipping. Threads on the bolts should be carefully examined and if found to be elongated, they should not be used. Steel bolts with strength of not less than 74,000 lb. should be used. After superheaters are applied, they should be pumped to the steam pressure of the boiler and thoroughly inspected to see that all joints are tight.



Method of Renewing Ends for Superheater Units—A. T. & S. F.

Methods Employed on the "Big Four"

Two plants are used for the repairing of superheater units. The plant in the machine shop consists of a reservoir 30 in. by 36 in. which contains two-thirds water and one-third air when charged for service. There is a hydrostatic pump and gage in connection with this reservoir and a sealing cylinder used for sealing the ends of units when testing. A three-way valve having seven ports, is specially designed to complete the entire operation of testing by three movements or positions. These positions of the valve admit air to the unit from the main reservoir to charge and seal the unit; this is the first step taken in this operation. The next is lap position which is also the exhaust position and the other position is known as water position.

The sealing cylinder is specially designed to seal both ends of the unit and form an unrestricted communication between the main reservoir and atmosphere at the lower end of the operating valve. It is provided with a "T" head piston, hollowed out to slip over each unit, coming in contact with the back of the unit head, bringing it against the rubber insertion in the bottom head of the cylinder. The operation is as follows:

Air is admitted to the unit by placing operating valve in "air" position, the air passing from the main air supply through the operating valve, the unit and into the main reservoir. As the air passes through the sealing cylinder the piston is raised by air pressure and seals the unit to the cylinder. Pressure is allowed to accumulate in the main reservoir and unit. The operating valve is then placed in the water position and the exhaust valve under the operating valve opened, allowing air from the unit to escape to the atmosphere. The air pressure in the main reservoir forces water into the unit when the air is released. When water shows at the exhaust port, it is then closed and the hydrostatic pump applies 350 lb. pressure. To release the water from the unit,

the operating valve is placed in the air position, the valve on the main reservoir is opened to allow the pressure to escape and air from the line drives the water back into the main reservoir, leaving the unit free from water. Air from main line is then closed, the exhaust valve opened and unit unsealed.

For repair of units which are bent, at the opposite end of this unit table are two air cylinders placed vertically, one placed over the other, but having separate pistons. The upper cylinder is provided with a continuous piston, traveling through both heads, and is used as a ram to give the bottom cylinder a blow when the air pressure in the lower cylinder is insufficient to straighten the bend in the unit. The lower cylinder also has a double end piston that gives the upper cylinder contact outside of the cylinder. The lower cylinder is used as a squeeze to straighten all four lines of the unit pipes at one time, these lines being separated by sheet metal shims laid horizontally and vertically, adjusted near the point where the piston of the cylinder comes in contact with the unit, properly spacing the four lines of pipe.

If leaks develop under hydrostatic test, these leaks are thoroughly sand blasted, removing all carbon and scale, and the leak is repaired with the acetylene torch.

A portable testing outfit is provided that can be taken to places throughout the shop where units have been removed for testing and grinding only. On either of these plants, the actual time taken for testing a unit is not over two minutes.

In the heavy repair plant, located in the boiler shop, there is a forging machine, with suitable dies for renewing the return bends, and a similar testing plant to the one mentioned above. There are also metal cutting saws for sawing off defective return bends, a sand blasting device for removing all foreign matter from the ends of the units, and a reaming device for reaming the ball ends of the units to the proper radius, preparing them for grinding.

From past experience it has not been profitable to use header bolts with a tensile strength less than 74,000 lb. These bolts are tested for elongation by gaging the thread.

The first superheater equipment was applied in July, 1911, and it is impossible to give the average life of units as the first ones applied are still in service. Units are not scrapped due to loss of weight. The use of micrometer calipers has indicated that the deterioration of the unit is very uniform, there being scarcely any variation between the front end and back end of unit. The most common failures are right at the end of unit where it comes in contact with cinders, and where it is subjected to the greatest temperature. When renewing return bends only enough is cut off to renew the bend. It is not necessary to make any sacrifice in the length of tubing because of the deteriorated condition of that part of the unit.

The report was prepared by the following committee: W. L. Jury (A. T. & S. F.) chairman; J. E. Stone (Sou. Pac.), J. Martin (Big Four), E. P. McDonald (Sou. Pac.) and C. L. Walters (Gt. Nor.).

Discussion

There was considerable discussion of the methods of taking care of header joints. While much of this dealt with the ball and cone joint it developed that a number of roads still use only the ball socket joint in the header. In the discussion on methods of grinding the ball and cone joints, a question was raised as to the necessity of grinding this type of joint since it is evident that the ball has a line joint in the header. With the ball drawn up tight this is bound to crease the joint and a great deal of care in grinding seems unnecessary. It has actually been found unnecessary to grind the joints more than just to clean them up. On the Grand Trunk where this practice has been followed, only two units have been found to leak out of 800 tested. This experience has confirmed the belief that it does not pay to test the units on the erecting floor as the few leaks that develop on the hydrostatic tests can then be touched up without much trouble. Others considered the floor test desirable, however, for the sake of safety and to detect leaks in the back end of the units, which, should they develop under hydrostatic tests, might make necessary the removal of several units in order to get at the defective one.

Attention was also given to the application of the units in the superheater flues, some members considering improper application as the greatest source of leaky joints and, therefore, that attention to the fit of the unit in the tube and to the location of the header, which must be properly lined up with respect to the tube sheet, is of greater importance than attention to the joint itself. Trouble has also been caused by the accumulation of corrosion on the surfaces of the slots in the header, the crushing of which causes the joints to loosen up and leak.

REDUCING THE COST OF REPAIRS TO CARS AND LOCOMOTIVES

The committee dealt with this subject under 17 heads, each of which was outlined briefly with the purpose of stimulating discussion. An abstract of these subdivisions follows:

SUPERVISION

Careful, well trained supervision is essential. Supervisors should have, or acquire, executive ability—the gift of handling men properly; they should be interested in their men and like them. They should be big enough to get their heads and shoulders above the petty envy and jealousy that has a habit of creeping in. Supervisors who are favored with the opportunity to get a schooling in different departments or experience in different shops are indeed fortunate, and can and do return the favor to the company they are working for.

ORGANIZATION OF SUPERVISORS AND SHOP FORCES

In order to have an efficient, energetic and interested shop organization it is necessary to have the co-operation of all members of the staff. To increase this spirit it is advisable to have weekly shop staff meetings at which the welfare of the shop is discussed. At these meetings the shop superintendent or general foreman can get in personal touch with his organization and get a general idea of the condition of each department by the report that each department foreman turns in. This enables him to make any changes which he might deem necessary to further the production in his shop.

At these meetings, too, subjects may be brought up for general discussion, such as general shop conditions or methods to be adopted to shorten the time of machine or erecting floor operations, which tend to decrease the cost of repairs.

ROUNDHOUSE REPAIRS

The first object should be to take care of the small repairs on locomotives, which will take only a short time and require a small amount of material before they cause damage which will require more costly repairs. Roundhouse work properly looked after keeps locomotives out of the back shop a much longer time.

Roundhouse terminals should be provided with inspection pits for inspecting locomotives before passing over the ash pits in order to detect any parts that need repairs and have the information forwarded in advance to the roundhouse so advance preparation can be made for repairs.

BACK SHOP SCHEDULE

There must be a workable shop schedule or plan for getting the work out with the facilities contained in the shop. Since the piecework and bonus systems have been discarded it has been found that production has slowed up. much to the dissatisfaction of all of us. It has, therefore, been necessary

to develop a shop scheduling system to take the place of the other systems.

MACHINERY AND FACILITIES

When it is possible to get new machines or appliances to replace old types they should be obtained immediately, but when this is not possible every loose end should be gathered in and the best made of the situation. There is more money wasted in making repairs to locomotives on account of the use of old and obsolete machinery than there is from any other cause. This is also true on mill work in the car department.

During the past few years locomotives have been growing in size and weight very rapidly; but in many cases the repair shops have not kept pace with them, and the result is high costs of repairs.

There is also another means by which the cost of repairs may be materially reduced and that is by the introduction on the machine floor of jigs, chucks, dies, box tools for brass work, pneumatic clamps, gang tools, milling cutters, templates and expanding mandrels, all of which reduce the cost of machine operations. On the erecting floors, power-driven valve setting rollers, motor-driven valve bushing pulling bars, rings for grinding cylinder faces and cylinder heads with air motor attachment, motor-driven flue cutters and flue rollers and chucks for grinding steam pipe rings and superheater units with motors have been found to greatly reduce the costs of repairs.

ROUTING AND LOCATION OF FACILITIES

All work going through shops should be properly routed, thereby doing away with unnecessary handling, which costs money. For example, all side rod work should be confined to one portion of the shop with rod rack, drill press, power press and lathe in close proximity to one another so that there will be no lost time between the several operations on the different machines. The driving box gang should have the power press, brass crucible for pouring hub liners, planer, boring mill, lathe and shaper within a radius of 10 or 12 ft., as they are in so many shops, so that when a driving box enters that radius it does not get away from it until finished and ready for application.

MATERIAL

Sometimes very little attention is given to the handling of material. A high rated mechanic may sometimes be seen pushing a truck up from the stores department with a load of material on which he is about to perform some kind of work.

This task should be taken care of by a trucker or laborer, thereby saving the difference in the two men's wages while at the same time the mechanic may be used on production.

Every effort should be made to have material placed in well regulated store departments so that when men are sent for certain articles they do not waste time looking for it.

The material required at the shops should be carefully watched by the supervisory forces and ordered in ample time to save delay and avoid the necessity of having to rob material from one engine or car for repair parts to use on another engine or car. Supervisory forces should keep in close touch with the consumption of material and should see that new material is not used unnecessarily, and that all second-hand serviceable material is handled properly to get the greatest amount of service out of it.

A well organized and well equipped central reclaiming plant is a great money saver.

PROPER HANDLING OF LABOR

Every employee should be impressed with the necessity of reducing all unnecessary expenses. A great many men are inclined to be careless about the use of material, especially when somebody else is buying it, and consequently, unless a strict check is kept, much of it is wasted.

To get the men thinking along the right line some roads have arranged to have efficiency meetings in the offices of the master mechanic, between representatives of the shop crafts and the members of the staff about once each month, at which the subjects of shop repairs, use of material and the elimination of waste is discussed. These men take part in the discussion and advance many ideas from the employees' viewpoint which save time and material. Then once in eight or ten weeks a mass meeting is called in the shop 30 minutes before quitting time at which some member of the staff speaks, followed by a representative of the employees, who bring before the men the necessity for conserving material and thereby causing reduction in the cost of repairs.

A spirit of hearty co-operation should be cultivated between the engine crews, road foremen, and shop forces in order to get the help of the engine crews in carefully handling and looking after the engines on the road and making their work reports as explicit as possible.

WORKMANSHIP

Another manner in which the shop organization can keep the cost of repairs down is to insist upon each man doing his work thoroughly, instead of accepting slighted work, which is sometimes done because the engine is wanted in a hurry. This is a very expensive measure because it will not be very long before the job will have to be done over again, at the same expense if not more.

When cars and engines are shopped for general repairs, all parts should be carefully inspected and necessary repairs should be carefully and properly made. They should leave the shop in first-class condition, to render satisfactory service without it being necessary to expend much on them for running repairs. Running repairs are more expensive than back shop repairs because facilities are lacking. Furthermore, the service of the engine is lost while such repairs are being made.

Close care should be given to the proper mounting of car and tender wheels on axles to see that they are properly centered and the wheel gage fits properly at least at three equally distant points on the circumference, and that wheels of same tape sizes are paired. This will tend to reduce flange wear and hot boxes.

WELDING PROCESSES

A great saving in material is effected by the use of the electric welding process. Locomotive parts which formerly had to be scrapped on account of wear, such as guide bars, brake beam ends, brake hanger pins, radius bar ends, fork ends of eccentric rods which have become too wide for the link, driving boxes which have been worn down on the shoe and wedge faces, are now built up by the use of the electric arc and made almost as good as new. The oxy-acetylene torch, in the boiler department especially, is being used quite extensively for the welding in of flues, flue sheets, side sheets and patches, thereby reducing the cost over the old method of applying them with rivets. The use of the cutting torch must not be lost sight of. There is no department which can get more results from it than the locomotive department.

LUBRICATION

The lubrication of the end play on driving, engine truck and trailer boxes, and shoes and wedges with graphite grease prevents the cutting of these faces and increases mileage.

Care should be used to see that the lubricating devices are maintained in good condition and that sufficient amount of lubricating oils are furnished to meet the requirements. Under the present conditions the proper lubrication of cars and engines depends to a large extent on the shop forces.

The supervisory officers should realize this and provide necessary facilities for properly lubricating and looking after the parts in the shops that are not ordinarily given the required attention on the road.

A trained force of men should be maintained to look after the proper packing and lubrication of journal bearings and this work should be followed up by the supervisory forces to insure that it is being handled properly at all times.

DESIGN

Great care should be given to the design of parts to see that they are of sufficient strength and of proper quality to meet the requirements of the service without failing; also to see that the parts on cars, especially, are so designed that they may be easily removed for repairs.

REINFORCING CARS

Draft timbers and gears on wooden cars are the source of high cost of maintenance. The substitution of steel center sills, to which the draft gear is attached, will almost entirely eliminate the maintenance of draft timbers and draft rigging, as it gives a substantial attachment to pull the train and also gives a buffing member which will prevent buckling of cars and, in box cars, the breaking of side plates over side doors.

This feature in present-day heavy trains will more than offset any additional cost of repairs to cars and will have them on the repair track less frequently. Another feature of importance is taking care of the breaking out of ends of box cars.

This can be done by substitution of pressed steel ends, of which there are several kinds on the market, and reinforcing the ends with structural shapes which can be anchored to the side framing, floor framing or roof framing.

INSPECTION

A system of careful inspection should be enforced to detect any defects which may develop that would result in failure or rapid deterioration of parts if not located and given prompt attention.

CLEANLINESS

Engines should be kept clean and of good appearance as both enginemen and shop forces will take more interest in the engines if they are kept clean. This should be followed up by the supervisors and necessary facilities provided to handle the work economically.

Shops and premises should be kept clean and all refuse and material picked up. This raises the morale of the men.

SHORT TRACKS IN CAR REPAIR SHOPS

It is necessary to have short tracks of 10 or 12 cars capacity, and many of them, in order to get bad order cars spotted with regard to the work to be done on them. Short tracks will also aid in more frequent pulling of the bad order tracks and not hold up a large number of cars as is done on long repair tracks. The repair forces can be better supervised with short tracks and material is more easily handled.

CLASSIFICATION OF BAD ORDER CARS

Bad order cars should be classified as to light, heavy, general repairs and steel work or other special work before they are set on the repair track. This method increases the output, allows the work to be specialized and reduces the cost of handling material.

The report was signed by C. F. Baumann (C. & N. W.), chairman, C. W. Adams (M. C.), H. T. Cromwell (B. & O.), and F. L. Wysong (N. & W.).

Discussion

As a means of broadening the experience of supervisors, the discussion indicated that many railroads have adopted the policy of sending groups of their foremen from time to time to visit the principal shops of other railroads. Where this practice has been followed the opinions expressed in every case indicated that the return to the company justified the practice. The value of reading suitable mechanical journals was also mentioned as a means of education which should not be neglected.

The opinion was also expressed that a real foreman requires qualifications which he possesses before he becomes a mechanic. In selecting foremen those men who have demonstrated qualifications of leadership should be tried out as acting foremen in advance of their selection to fill permanent positions.

The discussion indicated that shop scheduling is rapidly coming into general use. The systems described by those taking part in the discussion varied considerably in the details. Most of them, however, depended on periodical conferences of the shop foremen as a means of fixing the outgoing dates which, once established, are followed up consistently by means of schedule boards and daily reports.

The need of close supervision of speeds, feed and depth of cuts on machine tool work was brought out as particularly important at this time in efforts to secure adequate output. Many of the men on machines now seem to have little idea as to the capacity of high speed steel cutters and show little ability to figure out correct speeds and feeds. The tendency, therefore is to take more cuts than are necessary and operate at speeds which waste time. The discussion on workmanship dwelt largely with the importance of eliminating all unnecessary finishing of parts. Since the abolishment of premium and piece-work systems, where these were formerly in force, there has been a tendency for the men to do unnecessary work. In some cases this has been remedied by taking the matter up through the shop committees and impressing on them the need to avoid every possible waste of time.

During the discussion on the welding processes, Professor A. S. Kinsey, Stevens Institute of Technology, addressed the association as a representative of the Welding Conference Committee of the American Welding Society. Professor Kinsey dwelt on the importance of foremen having a more thorough knowledge of the essentials of good fusion welding. He referred to the fact that the Boiler Code Committee of the American Society of Mechanical Engineers will probably give a rating to fusion welds in boiler work and that the rating to be given will depend upon the kind of work that is being turned out. The foreman should know what kind of welds he is getting. Professor Kinsey referred particularly to the National Agreement as a hindrance to the full development of the possibility of fusion welding in railroad shops, since it places the welding jobs open to the senior craftsmen in the various departments, who may not be welders at all.

In discussing the sections of the paper dealing with car maintenance the present practice of maintenance, which goes on patching up the cars while giving no systematic attention to the draft gears, was condemned. It was stated that the same need exists for periodical inspection and repair of draft gears as has led to the present methods of air brake maintenance, and journal boxes. It was pointed out that such a policy adopted with respect to draft gears would soon demonstrate what gears are most economical. The value of the short repair tracks of 10 to 14 cars capacity was endorsed by the car men present.

Other Addresses

T. H. Goodnow, superintendent car department, Chicago & North Western, addressed the association on the problems of the car department. At the outset he called attention to the changed conditions surrounding the relations of foremen to their men, which must now be on the basis of a close

personal contact. These conditions the older men find hard to meet but the younger foremen should have no difficulty in conforming to them. Contrasting conditions in the car department to those in the locomotive department, Mr. Goodnow said that the greater part of the money spent by the car department is for work on outside repair tracks where the need for supervision is greater than in connection with any other railroad activities. Under the piece work system the men constantly kept after the foremen to see that they were furnished material. Since the piece work system has been abolished, however, conditions are reversed; the foremen must now closely watch the men to see that they are not idle because of lack of material at hand.

Mr. Goodnow called attention to the fact that the retirement policies of the railroads had to be abandoned a few years ago, thus continuing in service many old cars of light construction. Cars now cost not less than three times what they did in 1916, but in adopting a re-enforcement program it must not be overlooked that the same conditions prevail with respect to the material required to make the re-enforcements. It must also be taken into consideration that the small capacity car is a low earning unit. Where wood cars of 80,000 lb. capacity can be re-enforced at a cost of about $300 to $500 a good earning unit is provided.

E. W. Pratt, formerly assistant superintendent motive power of the Chicago & North Western also gave a short talk before the convention in which he commented on the fact that most of the subjects for discussion on the program dealt with apparatus or were of a technical nature, while every general foreman in the association probably owed his best job to his ability to handle men. Mr. Pratt suggested that the association might profitably give more attention to subjects dealing with the handling of labor and shop organization.

Election of Officers

The following officers were elected for the ensuing year: President, J. B. Wright (Hocking Valley); vice-president, G. H. Logan (C. & N. W.); second vice-president, H. E. Warner (N. Y. C.); third vice-president, T. J. Mullin (L. E. & W.); fourth vice-president, C. A. Barnes (Belt Railway of Chicago), and secretary-treasurer, William Hall (C. & N. W.). M. H. Westbrooke (Grand Trunk Western) and D. W. Adams (M. C.) were elected to fill vacancies on the executive committee.

CARS MUST BE EQUIPPED WITH SAFETY APPLIANCES

The Interstate Commerce Commission has denied the application of the American Railroad Association on behalf of various railroad companies for a further extension of time within which to make their freight-train cars conform to certain of the standards of equipment prescribed by the commission pursuant to the provisions and requirements of the safety appliance acts.

In accordance with the authority conferred by the provisions of the act the commission had granted successive extensions of the period within which common carriers should comply with the requirements of its order of March 13, 1911, with respect to the equipment of cars actually in service on July 1, 1911, as follows: On March 13, 1911, an extension from July 1, 1911, to July 1, 1916; on November 2, 1915, a further extension to July 1, 1917; on April 12, 1917, a further extension to March 1, 1918; on February 1, 1918, a further extension to September 1, 1919; and on August 29, 1919, a further extension to March, 1, 1920, making one continuous period of eight years and eight months from July 1, 1911, to March 1, 1920. Passenger-train cars and locomotives were equipped in conformity with the standards within the periods prescribed by the first extension order. The second, third, fourth and fifth extension orders pertained to paragraphs b, c, e, and f of the original extension order, paragraphs a, d, and g being so worded as to require no further action.

"The record shows," the commission says in its decision, "that on February 1, 1920, there were 2,319,380 freight cars owned by the carriers represented at the hearing, and that 60,170 of these, or 2.6 per cent of the total owned, were not equipped in conformity with the standards prescribed by the order of March 13, 1911. It is estimated that 3,000 were equipped during the month of February, and that 12,021, or 20 per cent, were special service cars or others cars which do not leave the owning line.

"No reason was given why these 12,021 special service cars have not been equipped in conformity with the law or why they cannot immediately be so equipped. This leaves 45,149 other cars to be equipped. Sixty per cent of them need minor repairs only, but more or less difficulty is involved in equipping the remaining 18,060. Of these, 9,272 have less than ten inches end-ladder clearance. If a special drawbar is used, the larger percentage of the 9,272 cars can be made to conform to the requirements. The number of bad-order cars on the lines of these carriers is about 138,000, or approximately 6.5 per cent of the total number owned. The percentage of the number of bad-order cars has fluctuated during the last two or three years between a little over 5 and about 10 per cent. Most, if not all, of these non-equipped cars have been through the shops in the last 9 or 10 years. A witness for the carriers stated that he did not know that any car could stay out of the shop that long.

"It can not be maintained that the failure to have these cars equipped in conformity with the standards is due to any unforeseen contingency. The requirement for the standardization of safety-appliance equipment is of long standing, and attention has been directed to this requirement from time to time in previous hearings in this matter as well as in the several extension orders; at the hearing in August, 1919, the situation was discussed and the understanding was had that no further extension would be necessary, asked, or granted. The arguments that shortage of material and absence of the cars from the lines of the owning carriers have delayed the required standardization are not convincing with respect to those cars which require only minor repairs, inasmuch as safety appliances are of standard dimensions and an order issued by the Railroad Administration June 30, 1919, required each carrier to equip all cars on its line not already standardized, regardless of ownership. We have seen that it will be more or less difficult to make 18,060 cars conform to the standards. But if these 18,060 cars are added to the number of bad-order cars, shown by the record to exist on the lines of the carriers, the percentage of bad-order cars will be increased less than 1 per cent, or from 6.5 to 7.3 per cent; and if the entire 60,000 cars not equipped according to standard were added to the number of bad-order cars the percentage of such cars would be increased to 9.2 per cent, a figure less than the maximum, which, according to the record, has existed during the past two or three years.

"It is noted that all of the unstandardized cars referred to herein were in service July 1, 1911, and all of them are consequently nine or more years old. No doubt many of these cars have practically outlived their usefulness and nearly reached the age of retirement. Cars of that age, if they have not heretofore been shopped for extensive repair work, must shortly go through the shops, at which time the safety-appliance equipment can and must be made to conform to the standards.

"Upon consideration of all the facts of record we are of opinion and find that good cause has not been shown for any further extension of the period of compliance and that serious burden or hardship will not be imposed upon the carriers or upon the public by denying the application."

PAINTERS HOLD FIFTIETH ANNIVERSARY CONVENTION

Equipment Painting Division of the American Railroad Association Holds Convention in Boston

THE convention which met in Boston on September 14 was an event of unusual interest and importance to the members of the Equipment Painting Division of Section III, Mechanical, of the American Railroad Association. It is the first convention of this association as a division of the American Railroad, as within the past year the Master Painters became a unit of the American Railroad Association. The Master Car and Locomotive Painters' Association was organized in the city of Boston in 1870 and in the opening exercises of the fiftieth convention, the association was addressed by Mr. Warner Bailey of the Boston & Maine Railroad, who took an active part in the organization of the association and who is now the only living charter member.

Warner Bailey's Address

The following is taken from Mr. Bailey's remarks in regard to the origin of the Association and his splendid conception of its purpose in promoting the welfare of the American railways:

"In the summer of 1870, Hill of the Portland & Kennebec Railroad; Cox of the Eastern Railroad; Scott of the Boston & Lowell; Lunt of the Fitchburg; Platt of the Old Colony; Ford of the Boston & Worcester; and Bailey of Boston & Maine, met together by previous arrangement and talked over the question of forming this association. I was chosen for the task of addressing a circular letter to be sent to foremen painters and the only guide I had was 'Poor's Railroad Manual.' In most cases only the president's and superintendent's names were there given and the call was sent to them with a request that it be handed to their foreman painter. On November 6, 1870, when the meeting was called, sixteen members responded. Hill of Augusta was made chairman of the meeting. After appointing a committee to draw up a constitution and by-laws and selecting a few subjects to be discussed at our next meeting we adjourned to meet in New York City the following year.

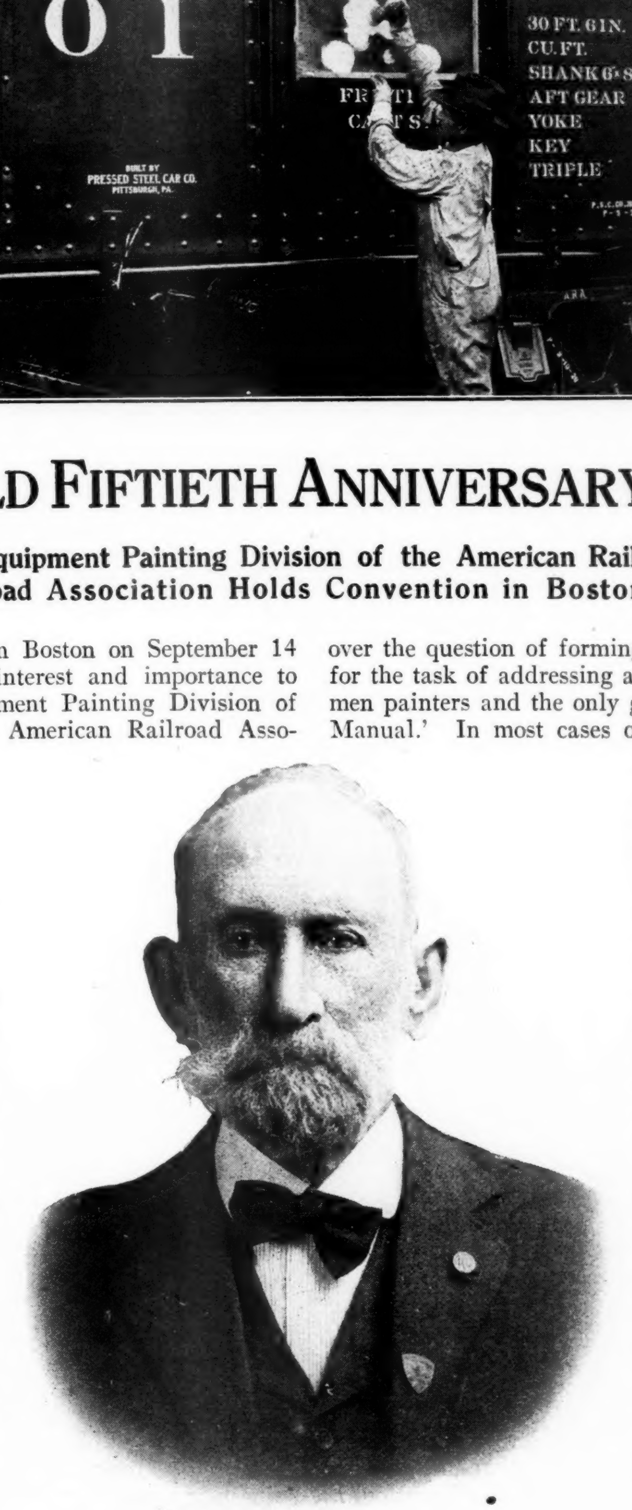


Photo by Kimball Studio, Concord, N. H.

Warner Bailey

"For many years we, as an association, struggled along without much increase in numbers, and little encouragement from any source, until we added to our numbers by taking in foremen locomotive painters and foremen of car manufacturing shops, both steam and street car. Also Canada was admitted with this addition, and today we number about three hundred members.

"We have always kept in mind the object of this association, as stated in the circular letter issued for the first meeting; and that was to perfect ourselves in our trade that we might be of more benefit to corporations employing us. I think we have always kept this object in view; and that

our yearly reports prove this.

"Among the notable members that have belonged to the association, who in times past have added greatly to our information, is James A. Gohen. Quest, with his technical papers, and Miller, with his practical papers, have added greatly to our knowledge, while Copp, Butts and a score of others of equal note have helped to make this association what it is today.

"What is the prospect for our association? I can safely say that this association will keep on indefinitely in its career of usefulness if the same principles actuate you as moved the founders of it; and this was to perfect themselves in their trade. If you know it all, then there is nothing for you to do but quit these assemblies, unless you come together wholly for a good time; and in this you might well consider whether or not it might better be spent in other ways and places. We do not know it all yet. New kinds of equipment and new ways of doing things are constantly developing and you will always want to keep these meetings going to discuss them.

"A year ago you dropped your name and entered the American Railroad Association as a unit in that great and useful organization. Let us hope this will widen the scope of your usefulness, as doubtless it will."

Chairman Gibbons' Address

In his opening address, Chairman J. W. Gibbons of the Atchison, Topeka & Santa Fe spoke of painting as one of the oldest arts, deriving its origin and receiving impetus in the desire of the human race to beautify its surroundings. Thus, in the beginning ornamentation was the dominant feature that impelled or inspired the craftsman. As the art progressed and developed, the thought of the painter was to preserve his work for the pleasure and inspiration of future generations. In order to accomplish this purpose, he studied the vehicle that carried and held his pigments together and assisted him to make the correct blend and shade of color, as well as protect the finished product from the ravages of time and weather. As the use of wood became more general, the quality of oils and gums became more important and were not only used to preserve the wood but to beautify it by imparting to it variegated colors and a lasting polish.

To solve these problems which have developed with the advent of the railways, Mr. Gibbons said that the painters realized the necessity of getting together for the discussion of application and formulating combinations of vehicles and pigments best adapted to perform the service required. With this object in view, The International Association of Master Car and Locomotive Painters was organized fifty years ago. When it is realized that at that time it required from six to ten weeks to paint a railway coach with no better or durable surface than we now secure in fifteen to eighteen days, it proves that these painters must have been inspired with the same independence of thought and action that inspired the patriots of American colonies to discard the traditions and prejudices of the past and build for the present and the future.

Chairman Gibbons stated that the paint manufacturers have derived more benefit from the work of this association than the railroads, because the manufacturer's welfare and success in business depended upon his keeping in touch with the most advanced thought of the day pertaining to paint, while on the other hand railroad mechanical officials have frequently and openly declared that the paint questions was the least of their troubles and are wasting thousands of dollars every day by the purchase and application of poor paint.

In concluding his address, Mr. Gibbons said that no section or department is undergoing such rapid changes as that of paint, its manufacture and application. The high price of raw materials, heretofore recognized as essentials, has offered a great temptation to substitute inferior materials into the finished product and it devolves upon the association to point out how far we can go with safety and economy along this line.

J. W. Gibbons
Chairman

E. L. Younger
Vice Chairman

V. R. Hawthorne
Secretary

Business of the Association

The chairman announced that during the year the association had received a number of new members and that at the present time the membership of the Equipment Painting Division of Section III-Mechanical, of the American Railroad Association was in excess of 500.

The committee on direction, as its name indicates, directs the affairs of the association between conventions and was requested by the A. R. A. to elect a committee of three to act with a similar committee from the purchasing, stores and chemical sections to prepare specifications and arrange tests for paints and varnishes. Mr. John Gearheart, Mr. John D. Wright and the chairman were elected to this committee. The committee at its last meeting passed a resolution requesting the committee on nomination to select the 1st and 2nd vice-chairman with the idea of their promotion in rotation and that the 2nd vice-chairman be selected from the board of directors and the selection of new members of the board from members who on the committees and on the floor have demonstrated their ability in this work. The division was requested to appoint a committee to co-operate with the Committee on Car Repair Shop Layouts of Section III-Mechanical, and the Committee on Shops and Terminals of Section II-Engineering, for the purpose of arriving at standards which would assist in the design for future paint shop construction. The new Committee on Direction was instructed to select a committee for this purpose.

The chairman expressed the thanks of the association for the frequent advice and courtesies extended by the officers of

the American Railroad Association and particularly for the very able assistance rendered by Mr. Hawthorne, secretary of mechanical section and this division.

The convention adjourned after electing the following officers for the ensuing year: B. L. Younger, Missouri Pacific, chairman; J. G. Keil, N. Y. C., first vice-chairman, and J. R. Ayers, Canadian Pacific, second vice-chairman.

THE ECONOMICAL PAINTING OF PASSENGER TRAIN STEEL CARS

BY G. H. HAMMOND
M. St. P. and S. S. M.

On a sand blasted car there is generally applied a coat of steel primer which is followed by several coats of steel surfacer. After the surfacer has been made smooth, two coats of body color are applied followed by the necessary lettering, and the whole protected by two or three coats of body varnish.

The steel primer comes to us all ready to apply, and is highly recommended for the first coat on steel. The material is a thin varnish-like substance, colored or clear according to its source of manufacture, and is *not* recommended as a protection to steel when used alone. It must itself be protected by other paints.

What is surfacer, and why is it applied to steel cars? It is simply another form of putty, and the only reason why it is used is to obtain a smoother and more level surface. For this reason its composition must of necessity be inelastic and chalky. If exposed to the weather alone it would fail completely.

After the surfacing coats have been worked into a satisfactory condition, the color coats are applied to it. These two color coats are made up of body color ground in Japan and thinned to a working consistency by the mixing in of turpentine or turpentine substitute. The body color coatings if exposed alone to the weather would soon disappear and be of no value in protecting steel from rust.

So far in the process of painting a steel car three classes of materials have been used—the priming coat, the surfacing coats and the color coats, and none of these coatings, alone or together, would protect steel from rusting more than a short time. What then is the protection from rust? Varnish must be the answer; two or three coats are applied on top of all the previous unstable coatings. It must not only ward off the weather, but must also hold the previous coatings to their place.

This method of painting steel cars is simply applying to steel practices and material found adaptable to wood, and the results are not satisfactory. Cracking of the varnish, peeling, and rust spots appear all too soon. These coatings which are put on so carefully and part of which are rubbed off with equal care, and which we know to be so poorly adapted to the protection of steel, must be mainly responsible for the unsatisfactory results. This being the case why not eliminate such material entirely from a place on the bodies of our steel passenger cars, and not only save the cost of such material but the big item of labor required to apply it, and use only such material as we know to be elastic and durable?

One coat of body color and three coats of varnish is all that a steel passenger car body really needs and it will remain bright and lustrous much longer than those cars loaded with many coats. The body color should be furnished in paste form, ground in equal parts of raw linseed oil and gold size japan. To prepare it for one coat work on sand blasted steel or repainted cars, reduce it with raw linseed oil, and nothing else, to a consistency that will cover with one coat, apply with a bristle brush and smooth with a hair brush. The next day all necessary lettering is done. All places lettered with leaf should be well pounced with whiting before sizing to prevent leaf from sticking to body color, and be washed off when the lettering is dry. The following day the first coat of varnish is applied, followed by two more, forty-eight hours apart, until three coats are applied, at which time the car body is finished.

You will notice that no other work is done except these four coats and the necessary lettering, and you will perhaps wonder how a steel car finished in this manner would look. It will have all the brilliance of color and all the varnish luster that could be desired, and as for the smoothness of finish, unless a very close inspection is made, no difference in finish would be noticed. Cars constructed of plates riveted together will not show a level surface; regardless of what the painter may attempt to do to make it so, each plate will show bulges or depressions which are impossible to eliminate and barring deep pits in the surface of the steel, any surfacer or putty applied is so much material and labor wasted. Steel plates containing pits should never be accepted if placed in a position to show on the outside of a steel passenger car. Cars constructed of thin steel in imitation of wood sheathing are perfectly smooth and level before being sent to the paint shop, therefore any surfacer or putty applied would be superfluous.

When it is necessary to repaint, the old varnish is sand papered, a coat of oil color is applied, followed by three coats of varnish. After several shoppings such cars become just as smooth at close inspection as a surfaced car.

Discussion

J. D. Wright: The Association cannot go on record as recommending one coat of body color and three coats of the best outside wearing body varnish as a standard method of finishing the exterior of passenger cars. While the method may be feasible with an oxide of iron color, it may not be feasible with a color which is composed of ochre or chrome yellow and carbon black and a very small percentage of red, which are the pigments used in the manufacture of what is known as standard Pullman body color.

J. B. Ayers (C. P.): Dr. Johnson, engineer of tests for the Pullman Company, told me up until six or eight years ago considerable cold rolled steel was used in the construction of passenger equipment. That steel is very similar to the present steel extensively used by the automobile body builders. That steel is smooth and does not contain flash scale or pits. I believe cars on the Soo Line are fortunate enough to have steel of that character.

Mr. Butts: As an experiment I took two Pullman coaches, and treated them exactly the same, the same day, with the same kind of material. One was put on the run north to Winnipeg and back, and kept on that run for twelve months. The other car, painted exactly the same, went on the Portland, Oregon, run and was kept there for twelve months. At the end of the twelve months the one on the Winnipeg run was in fine condition, needed nothing but touching up the varnish. On the one on the Portland division, the varnish was so badly decomposed that it had allowed the surfacer to be attacked by the alkali, and we had to burn the car off. You cannot adopt a standard for all parts of the United States and make it a success for painting passenger equipment.

REPORT OF COMMITTEE ON MAINTENANCE AND CARE OF PAINT AND VARNISH AT TERMINALS

The committee would first urge that the attention of passenger equipment at terminals should be under the supervision of a man who is familiar with the nature of paint and varnish, so that the cleaning done at terminals would not be done with materials and in such a manner as to injure or hasten the termination of durability to varnish and paint; that cars after coming from the shop freshly painted should not be cleaned with the use of a solution of any kind until such time as the condition of the car makes this absolutely

necessary. In maintaining and caring for the paint and varnish of such cars at terminals, a dry wiping with waste after each trip is all that is necessary. When the condition of the car becomes such that it is necessary to use a cleaning solution, an oil emulsion that is made neutral and has a tendency to feed the varnish should be used, care to be taken that it is wiped absolutely dry before car is again put into service, as car is bound to gather a certain amount of dust and dirt immediately after this treatment. After car has been cleaned in this manner, it can again be taken care of for some time by simply dry wiping after each trip.

The committee is unanimous in recommending that soap and water should never be used in the open air at terminals for cleaning the exterior of passenger cars, unless immediately rinsed off with clean water and dried thoroughly with a chamois, as the sun will dry soap and water on the surface of car very rapidly, thus injuring the varnish. A practical demonstration of this may be made by washing your automobile with soap and water and rinsing with clear water without drying thoroughly with a chamois.

Painted floors of cars should not be mopped with a strong solution of any kind, but when mopping is done use only a weak solution of oil soap with a proper disinfectant, which will not injure floors. If this practice is followed, floors will not require repainting as often as otherwise would be the case.

It is very important that roofs of cars be inspected frequently at terminals, and if necessary repainted without wait ing until the car is shopped for general repairs or repainting. If this practice is followed, it will tend to preserve the roofs so that when car is finally shopped for general repairs and repainting the roofs will be in good condition and will not need extensive repairs.

The interior of passenger cars should have the varnish or enamel wiped occasionally with cloth dampened with neutral interior renovating oil, which will brighten and renew the varnish or enamel greatly and improve the appearance of the interior and will also assist in preserving the varnish or enamel.

The committee does not approve of the use of washing or scrubbing machines on the tanks or cabs of locomotives, but sees no objection to their use in cleaning the frame, wheels, etc. It has been the experience of the members of the committee that the use of these machine on varnished surfaces is very injurious to the varnish.

Cleaning Enamel and Varnish Surfaces

In order to obtain the best service from cars painted with enamel without varnish, the car should be primed and surfaced in the usual way and given two coats of oil varnish enamel, which dies very slowly. It has been the experience of the committee that the clear varnish enamel does not give the same surface as the oil varnish enamel. The use of oil varnish enamel, which dries very slowly, necessitates allowing more time between applying coats, thus delaying the return of car to revenue service.

Gold leaf lettering cannot be used on such enamel, as the enamel being of a finishing coating the leaf adheres around the edges, therefore the lettering must be of an imitation of gold, that is a gold color paint. A car finished in this manner does not have the same high lustre nor give the same satisfaction in appearance as the car painted in the usual manner and given the usual coatings of clear finishing varnish, although, considering the first cost, the car can be painted with enamel for a few dollars less than with varnish. In cleaning the cars at terminals, however, the car with the varnished surface can be cleaned more easily and present a much better appearance and with less cost, because on the varnish finished surface the dirt has not formed a part of the painted surface. In the case of the enamel finished car, however, it is much more difficult to clean and does not present as near a satisfactory appearance after cleaning, as the dirt and dust adhere to the painted surface.

Another very important point and worthy of consideration is the fact that the enamel surface will not bear as frequent cleaning as the surface finished with varnish. When an enameled car is scrubbed, it is generally found necessary to enamel again with two coats and reletter car, while the varnished car can be scrubbed and either touched up and varnished or cut in and varnished, according to color of body, with less cost than enameling and relettering.

It was the conclusion of your committee that, giving due consideration to appearance and cost, it is preferable for the purpose of cleaning to have passenger equipment finished with varnish.

The report is signed by: A. H. Phillips, N. Y. O. & W.; J. W. Houser, C. V.; Jas Gratton, B. R. & P.; E. A. Witte, T. R. R. Asso., St. Louis; J. W. Quarles, C. & O.

REPORT OF COMMITTEE ON STANDARDS

The committee recommends the universal adoption of the standard of the former Master Car Builders' Association for uniform stenciling and lettering of freight equipment and suggests that every effort should be made to put this standard of lettering in practice. The universal use of this standard would eliminate the making of innumerable stencils and a great amount of hand work, and should bring about considerable reduction in expense.

The report states that the general adoption of this standard method of lettering freight car equipment would solve one of the perplexing and annoying problems which confront the railroad men entrusted with taking of car records. It is believed that the standard method of numbering and stenciling recommended by the former Master Car Builders' Association, and now a standard of the Mechanical Section of the American Railroad Association, would eliminate such errors and save much annoyance.

Exhibit "A" shows the cost of making stencils required for lettering freight car equipment of the different railroad lines. These costs are based on old figures and at rates of wages which have increased considerably since that time, so, in all probability, they would be from 30 to 40 per cent higher at the present time.

Exhibit A.—Cost of making special stencils for marking freight cars.

Pittsburgh & Lake Erie, 4 in. Roman	$5.00
L. E. & W. R. R., 5 in. Roman	2.00
L. S. & M. S. R. R., 5 in. Roman	8.00
New York, Chicago & St. Louis, 5 in. Roman	8.00
Pennsylvania R. R., 5 in. Roman	4.00
Buffalo, Rochester & Pittsburgh, 5 in. Roman	7.00
Lehigh Valley R. R., 5 in. Roman	6.00
Erie, 6 in. Extended R. R. Block	1.50
Michigan Central, 6 in. Roman	3.00
Chicago, Milwaukee & St. Paul, 6 in. Roman	8.00
C. C. C. & St. L., 6 in. Roman	9.00
C. I. & L., Roman	8.50
K. C. F. S. & M., 5 in. Block	1.00
Wabash R. R., 3½ in. Full Block	1.50
Northern Pacific, 6 in Roman	6.00
T., St. L. & W., 6 in. Roman	2.00
Missouri Pacific, 5 in. Round Block	3.00
Kanawha & Michigan, 6 in. Roman	4.00
St. Louis, Iron Mountain & Southern, 5 in. Roman	8.00
C., St. P., M. & O., 5½ in. Roman	9.00
Chicago & Alton, Extended Roman	4.00
Rock Island, 8 in. Roman	3.00
Grand Trunk, 8 in. Egyptian	3.00
Central Vermont, 6 in. Roman	4.00
Bangor & Aroostook, 8 in. Roman	4.00
Atlantic Coast Line, 4 in. Roman	3.00
Boston & Maine, 5 in. Roman	3.00
Norfolk & Western, Roman	6.00
Southern, 12 in. Roman	3.00
Mobile & Ohio, 6 in. Roman	3.00
Baltimore & Ohio, 5 in. Roman	3.00
Central R. R. of New Jersey, 5 in. Roman	5.00
Pere Marquette, 4 in. Antique Roman	6.00

On repair yard tracks it is estimated that 60 per cent of all repairing is to foreign car equipment, most of which requires the replacement of more or less stenciling in order to maintain the identity of the cars. This requires the repairing line to carry in stock stencils of nearly every type and size of

letter and number. Some of these stencils are used frequently and others not so often. Nevertheless, it is necessary to keep this stock of stencils, for most repairs are of the hurry-up kind which excludes off-hand lettering.

The committee recommends that trade marks or badges should be part of the expense for each individual car owner to assume if they wish same replaced on their equipment. The stencils for these trade marks are very expensive, as the attached exhibit "B" will show, and the committee would recommend their discontinuance, as the only reason for their use seems to be as a means of advertisement. Most trade marks require backgrounds other than the standard colors used for painting equipment, and thus require an extra application of paint. This necessarily delays the completion of the car and at the same time adds to the cost of stenciling.

Exhibit B.—Cost of Making Stencils for a Few of the Most Complicated Badges or Trade Marks.

Morris & Company, Old Style	$20.00
Nelson Morris & Co., Shaded	10.00
Louisville & Arkansas	4.00
Old Dutch Cleanser	6.00
The Niagara Falls Route	3.00
Clover Leaf, Plain	1.50
Arkansas River	3.00
Queen & Crescent Route, Egyptian	3.00
Ann Arbor	2.00
Philadelphia & Reading, Lower-Case Roman	2.00
Frisco System, 7 in. Egyptian	2.00
Lehigh Valley, Flag	2.00
Pennsylvania Lines, Arrow and Anchor	1.00
New York, New Haven & Hartford	12.00
Iowa Central	2.00
Wisconsin Central	2.00
Mobile & Ohio	1.00
Burlington Route	2.00
New York Central Lines	4.00

As the committee believes that economy is the watchword of the railroads today, the elimination of these shields and trade marks is one practical way to reduce expense.

Recommended Practice for Painting Freight Car Equipment

As the protection is an absolute necessity, the committee recommends that the new steel car should have a coat of red lead applied to all lapped parts before assembling. Upon completion of construction the exterior should be thoroughly cleaned and prepared by sand blasting. A priming or first coat of paint should immediately be applied both inside and outside. This should be a linseed oil mixture requiring twenty-four hours to dry.

The carbon blacks are the best wearing and the most appropriate coating for this class of equipment. After this, and perhaps but little less in wearing quality, are the oxide of iron pigments. The preparation of this coat, as to pigment and vehicle, should be such as to insure an ideal binding and elastic film. A second coat with about one-third more oil should be applied. Great care should be taken to see that every part of the car is covered. Both coats can be effectively applied by spraying. For patch work or repainting the same method should be applied as in new work, that is, all scale and rust removed and two coats of paint applied.

The recommendation of the committee is to use one coat of primer made from red lead and oil, followed by a coat of carbon black in oil. This has not been generally carried out because of the first coat of raw material, red lead being high in price. As an alternative, the committee would suggest the use of carbon black in oil or graphite, or preferably iron oxide in oil.

Carbon paints are not safe to use as contact coats on metal as they are good conductors of electricity and act as rust stimulants. However, they make good top coats. Graphite paints are not good inhibitors of rust because of the ease with which they conduct electricity. It has no action on oils except to retard drying. It is a greasy pigment and slides under the brush and the particles tend to segregate and should be mixed with a heavier pigment to give it tooth. Asphaltum and coal tar black has practically no value as a protective coating. It generally contains no oil at all, has very little toughness, and its acidity tends to promote action of rust.

No part of railroad equipment is more essential than the air brakes, and one of the most frequent causes for defective brakes noted is leaky trainlines caused from rusted pipes becoming weakened and breaking at joints. Air brake lines have been frequently observed in so rusted a condition that whole sections of the piping had to be removed on account of rust having caused the sections to become porous. For this reason it would seem most essential that they should be protected with paint and continually watched. A well painted air brake line will render inspection of this part of the equipment easy and will also lead to detection of flaws and breaks which can be reported to the proper officer.

Recommended Facilities for Freight Car Painting

The most convenient place to paint freight car equipment, weather conditions being favorable, is on the outside of shops located as conveniently as is possible to the place where the repairing is done. The longitudinal tracks are best adapted for this work and should be properly equipped with air lines, with plenty of space between tracks. A stationary scaffold of simple construction is very convenient and a great time saver. Care should be taken that such tracks used for painting should be kept exclusively for painting purposes, for the reason that the tracks must be kept clean of all rubbish or obstruction in order to facilitate the painting work and thus insure quick return of cars to revenue earning service.

The best system of painting freight equipment and in standardizing results obtained by such painting is to do the work in properly constructed shops. This will allow a uniform amount of work under varying weather conditions. It will also permit planning the work and directing it properly, rather than having cars located all over the yards and men working without adequate protection or supervision. Where spraying machines are used in closed shops, provision should be made for sufficient ventilation. There are times when freight cars can be satisfactorily and efficiently painted on the outside of shops, but during most of the year work in the North can only be properly done within four walls and under a roof. For this reason a shop for painting freight cars is both economical and efficient.

Recommended Frequency for Painting

It is becoming most essential because of lower production and higher cost of labor, material and new equipment, that greater care be taken in the inspection and painting of steel equipment on railroads. Attention should be given to inspection of freight cars at yards, and a repair or patching crew should be kept at principal junction points equipped with material necessary to fight rust. Steel freight cars should be brought into shop for repainting and repairing every three or four years.

Opinions vary very much with regard to the time a car should be brought in for general overhauling and repainting. If the initial preparation and painting has been properly done and cars not subjected to unfair usage, such as the hammering of sides for the purpose of dislodging, or the loading of hot slag or billets in cars, there is no reason why coal carrying cars should not give three years' service before reshopping. The use of such cars for storage of coal during winter months is very injurious as the sulphur drippings from coal will very soon destroy the paint film and cause corrosion to the parts attacked. All steel box cars, if properly painted at the beginning, should give a longer term of service. However, the under portions such as channel irons, underframes, etc., must be continually watched and kept painted.

In view of the above, it is the opinion of the committee that the standard practice on railroads should include thorough overhauling of all steel freight cars at least once every five years and the painting of underframes at every opportunity offered.

The report is signed by: S. E. Breese, N. Y. C. (chair-

man); G. J. Lehman, C. & E. I.; F. E. Long, C. B. & Q.; W. A. Buchanon, D., L. & W.; C. A. Cook, Pennsylvania.

Resolution Adopted

Whereas a large proportion of freight equipment cars in service bear markings not conforming to the American Railroad Association recommended standards as shown on drawings 26, 26a and 27, thereby making necessary the use of an endless variety of sizes and types of letters and figures. And whereas, the condition greatly increases the cost of repairs to foreign line cars, due to the necessity of applying markings by hand, or the making of numerous stencils for temporary use; and whereas, the condition is frequently the cause of wrong numbers being recorded by transportation department employees, causing confusion and needless correspondence; be it therefore resolved, that this division recommends any action necessary to urge all railroads to follow a uniform practice and use markings as recommended by the American Railroad Association, also that a rule be adopted making it permissible to use such markings, disregarding the manner in which the cars were previously stenciled, and making all marks of an advertising character billable against the owners.

INDIVIDUAL PAPER ON ECONOMY TO BE EFFECTED BY PROPER PAINTING

BY B. E. MILLER
Delaware, Lackawanna & Western

In order that economy in the maintenance of equipment by painting may be effected in the fullest measure, cars and locomotives should be shopped and given the needed attention whenever their condition demands it. Again the management has to be reckoned with. Can locomotives in serviceable condition be spared for painting? No. Neither can cars, especially freight equipment, when there is an abundance of business and a shortage of rolling stock. The consequence is frequently disastrous. Witness the present condition of the average freight car throughout the country today. The cars of all rairoads having been pooled during recent government control, little attention was given to the matter of painting. The result was soon apparent. Steel coal-carrying cars, many of which were in none too good condition when the government took hold, began to look disgraceful; rust, that arch enemy of steel, was making rapid progress. Some of the cars are in such bad shape as to make their cleaning up and conditioning for repainting practically impossible. In many cases, the last coat of paint, probably a poor article when applied, has disintegrated and washed off, leaving no protection to the surface and exposing double lines of lettering frequently, which, to say the least, is very annoying and proves the wisdom of applying a paint possessing durability, though it means perhaps a little additional time for drying or an extra coat of paint to insure wearing results. The present "run down at the heel" appearance of equipment might of course have been avoided had it not been for the war, scarcity of help, the peculiar conditions due to government control, etc. Had it been possible to give the cars *proper* painting when their condition made it advisable, many dollars might have been saved to the railroads, so far as the painting itself is concerned and deterioration avoided. Especially does this apply to steel equipment and steel portions of wooden cars.

True economy in the painting of railway equipment means to do the work promptly, once it has been determined that painting is necessary. This ought to be made plain even if there is no hope of influencing those who decide as to when cars can be spared from service for painting and when financial conditions will warrant the expenditures necessary to do the work.

Use only good serviceable materials. As a rule, it doesn't pay to bother with anything else. The present high cost of labor and the difficulty of securing it, demand that money shall not be thrown away, partly at least, in the direction of applying paints and other materials which lack efficiency and durability. It requires no mathematician to figure out that, as a rule, the higher priced material proves itself to be the cheapest in the end. This has been said so often and evidently with so little effect, that we almost hesitate to repeat it.

Purchasing agents, unless strong pressure is brought to bear, are inclined to invite ruinous competition when placing orders for supplies. In the matter of paints, as with other materials, they are apt to purchase solely on price, unless they can be successfully convinced that, in some cases at least, it is rank folly to do so. Happy indeed ought the painter to be whose complaints, when made to the proper official, receive the attention they merit and eventually reach the person responsible for the placing of orders. His duty and aim is to save money. If he can be thoroughly convinced that paying more for material means in the end true economy, he will often he persuaded to buy the higher priced goods.

Discussion

J. W. Gibbons (A., T. & S. F.): Five years ago, in a shop within my knowledge twelve per cent of all the steel cabs coming through required new roofs, because of improper painting and care. After the officials' attention had been called to that condition, and a standard practice adopted, not only of painting, but of keeping them clean, each year from that time until this day there has been a gradual lessening of expense, until last year there was not a single full roof put on any of the locomotive cabs coming through that shop. Five years ago there were twenty-five sides put on steel cabs; last year there were three.

I have noticed our steel passenger cars, the deck side particularly, panel after panel corroded through. If these had been properly painted when they were constructed or when they were in the shop at the last period, all of that labor and material would have been saved to the railroad company Our superiors oftentimes do not have the slightest idea of what could be saved by proper painting.

Very few of us can say that we are using the best material, and that has been particularly true in the last two or three years. Price has been the first consideration, but should be the last consideration. If the painter knows his business, his word should be accepted.

W. A. Buchanon (D., L. & W.): I have frequently had occasion to look over steel equipment, and just recently looked over some new steel equipment just from the factory that had been painted, and well painted as far as material went, over mill scale. It is the height of folly to attempt to paint over mill scale and expect it to stand. It should first be removed or you will throw away good material in painting steel cars.

W. O. Quest (P. & L. E.): The road I represent was one of the first to get steel car equipment. I remember reading an article by a mechanical engineer to the effect that a steel car would last thirty years on two paintings, the original and one painting afterwards. At that time I presume he failed to take into account how a steel car was to be abused around these mills, with hot slag and hot billets, and the other deleterious things that came afterwards. I recall reading another article in which another mechanical engineer claimed that in ten years they would be falling down on the lines, which also was a mistake.

Paint is necessary to keep steel cars to long life, the best paint you can buy and with the very best sort of application. The original painting must be considered. The original painting of steel car equipment should not be forced to the extent of two coats a day in order to get the equipment out. You have a great many cars, and it is difficult

to figure when you will get those cars in the shops. You say a car must come in every five years, but you don't know whether it will or not. But the thing to do is to paint every steel car.

REPORT OF COMMITTEE ON TESTS

The committee in its report has assigned each subject under consideration to an individual member of the committee. These individual papers have the approval of the entire committee and are presented herewith.

WHAT IS THE SO-CALLED FIXED PAINT OIL?

BY W. O. QUEST
Chairman, Pittsburgh & Lake Erie

Does the term fixed paint oil exclusively apply to the chemistry of paint making? Is this oil fixing confined to the proper fixing of commercial linseed oil, or does it mean that any kind or compounds of oils containing a partial or whole percentage of body weight lin-oxygen can be made through further admixture into heavy bodied substitutes that will answer the same purpose as the pure treated or properly fixed linseed oil. This question has caused much thought and study, owing to the fact that immense quantities of oils other than linseed are used today in paint making and consumption.

The writer is now offering something new along the line of oil fixing, which is an attempt at oxidizing non-oxidizing oils, with their after removal in film form for your tolerant inspection. These oils range from a locomotive cylinder oil down to the oil of goose grease. The idea of such a test was to ascertain if there was an available trick material that would oxidize or dry fix grease oils into films that could be removed—removed regardless of the apparent impracticability of the scheme. They may not mean anything, unless such tests would prove that there are oxidizing materials neutrally fit and strong enough to set up or turn a non-oxidizing oil into something like a fixed paint oil to a bodied film that can be removed, viewed and handled.

For your further information, will state that the same method and amounts of a specially made japan were used on all of the non-oxidizing oil films taken off, also that the drying time periods and results were fairly uniform. A fixed paint oil other than linseed should be so labeled, called by its right name; if not, the use of such spurious materials should not be encouraged in the railway paint shop.

COMPARATIVE VALUES OF TUNG NUT (CHINA WOOD) OIL $2.00 VARNISHES vs. THE OLD STANDARD FOSSIL GUM, SUCH AS ZANZIBAR MANILLA OR KAURI

BY THEO. HIMBURG
D. & R. G.

The committee calls attention to the fact that many American varnish manufacturing concerns claim they have discovered a dependable substitute for the old time honored, high priced fossil gum, railway body varnish which has always rated in the railway paint shop as the only acceptable grade of protective wearing varnish.

The committee has done some experimenting with china wood oil for its own benefit. Some linseed oil was boiled at 550 deg. F. for several hours, and it boiled slowly and uniformly. When china wood oil was heated to this same temperature it changed in a very short time from a liquid to a semi-solid state, in which form it was disintegrated and sticky. It seems that when wood oil is thus heated and solidified it is useless, because it is insoluble in turpentine, naphtha, benzol, alcohol or any commercial thinner.

There is one thing which can control it, and that is rosin. If rosin be added just at the point when the oil is passing from the liquid to this useless state, it brings it back to the liquid form. Furthermore, this action can be repeated several times and finally, when the mass is reduced with turpentine or other solvent, it soaks it up like a sponge. This phenomena is called false body by the varnish makers.

With exactly the same quantity of gum and oil they can, for example, make two varnishes of the same viscosity, but with one containing twice as much thinner as the other. It is obvious, though, one will have only half the true oil content of the other and proportionately less durability. To all physical appearances, such as body and dry, they are identical.

It is universally recognized that china wood oil fills a distinct need. It has unequalled waterproofing properties, but lacks the refinement and working of linseed oil. A proper combination of the two should give the ideal varnish.

A straight china wood oil varnish when allowed to stand open will first form jelly-like "gobs" and quickly skin over. Also, when it dries and is rubbed the film does not cut down cleanly like linseed oil, but it will be noticed particularly under a magnifying glass that it has a tendency to "rough."

Petroleum distillate has more cutting power than turpentine, that is to say, the addition of identical amounts of petroleum distillate and turpentine to the same quantity of a varnish will give a thinner body in the case of the one reduced with petroleum distillate. As there is no turpentine in these two-dollar varnishes, we therefore spread less of a wearing film on our work. Finally, the big saving must come in the gum, and it is apparent that they are rosin, or part rosin, varnishes and false bodied according to price, for the varnish maker is going to make his profit. We have had too much experience to compare high acid-bearing rosin with fossil gums.

To our minds it is a destructive chemical action which must certainly reflect itself in the durability of the varnish. We are decidedly not standpatters. The old varnishes cannot be compared with a blended varnish combining the best elements of both linseed oil and china wood oil, but we do not want any truck varnishes in our hands. We like to smell some turpentine in our varnish, and when we put on a finishing coat we want approximately 100 per cent pure oil content in the dried out film and not a manipulated one which gives us half the oil and half the durability which we have a right to expect.

STEEL PASSENGER CAR ROOF PAINT

BY F. B. DAVENPORT
Pennsylvania System

The paint maintenance of the steam railway passenger car roof has always been a serious problem from the pioneer day of the good old-fashioned iron-made, tin-roofed car down to the present time modern roof, which may be weather protected with canvas, burlap, wood fibre, paper, or the modern steel plate, which must be service protected with a good paint, usually either of the good old stand-by iron oxide or carbon black pigment made up roof coatings.

There should be no trouble with the modern steel car roof, if originally sand blasted or otherwise freed of dirt, grease, flash, scale or loose corrosive matter and followed up with especially designed paint, which if of good elastic material quality will give a maximum of service results, as practically proven up to date. Regardless of pigment used, a tough, hard elastic varnish-like priming coat should be applied on the roof of the new steel passenger car. Repeated hard, long oil in suitable heavy oil-bearing pigments of fixed, never-changing standards should also be used for all subsequent roof coatings while the car is in service. There possibly may be better roof paints than those made of long oil and the usual calcined oxides of lead, iron and carbon blacks. The committee has attempted to test out several of the so-claimed to be fixed combinations of essential oils, gas coal, asphaltum, pine and kettle bottom tars, fire-flame proofed with asbestos or magnesia fibre. The slower oxidizing oils and pine tar are

undoubtedly most successfully used as oxidizing retarders.

The test committee had the opportunity of investigating the practical service time applied, also the shop test results of several of the new idea tar combined paint or roof cements. The tests proved that regardless of the promoters' claim for the best of these roof cements, the metal surface of the new or old roof had to be thoroughly cleaned and freed of dirt, grease, rust and scale, also that brushed on coats gave better protective wearing results than the heavy knifed-on single coat, also that the mixed-in asbestos or magnesia fibre made a better fire resisting material where reduced almost to a dust. The hard set up and the time continued elastic wearing qualities of these tarry combinations are going to prove worth investigating.

Arranged hot coating tests, also shop practice results show that the use of the best or worst surfacing system priming materials on the new steel passenger car roof is a mistake, owing to the fact that, as a rule, such quick-drying make-up primers will not for any length of time withstand the intense heat of the sun's rays as attracted by the solid metal roof surface. An all-steel passenger car roof is no place for a volatile paint of any kind. It has also been practically demonstrated that it is a mistake to sand the entire metal roof of a steel car, as the applied sand is also a strong sun attractive that helps bleach out the much needed elastic life of the oil in the roof paint. As stated above, all new coatings or recoatings will give better and longer service results where the same formulas of mixed paint stock are used on all protective coatings applied.

THE CHEAP DENATURED ALCOHOLS VERSUS THE GRAIN-PROOF ALCOHOL IN RAILWAY CAR PAINT SHOPS

BY J. N. VOERGE
G. C. & S. F.

Will the future practical tests show that the cheaper vegetable commercial alcohols, lawfully denatured with some solvent mineral spirit, make a dependable substitute shellac varnish for the railway car paint shop? Owing to prohibition, the ban has been put on all things purely alcoholic. The privilege of shop handling grain-proof alcohol, owing to the strict government regulation is a thing of the past.

A good substitute shellac is the cry of the hour. As an offered remedy material, we have many laboratory products of the volatile solvent kind, which include the denatured alcohols, also several of the deodorized acid ether derivatives, including the coal tar by-product ethers; the latter in many cases were found to be more neutral and better solvent gum cutting mixtures than many of the alcohols. The cheaper mineral spirit, vegetable denatured alcohols, in our judgment, made a fairly satisfactory shellac varnish under test. The material dries a little slowly, also was found to be very quick in turning dark where too long exposed to the air in coating application, but we found it would leave a tough elastic shellac film, a tougher film we think than all grain-proof alcohol shellac will leave.

The 10 per cent alcohol denatured cheap vegetable alcohol would make a shellac varnish equal to any requirement of the car paint shop, but its practical use for the purpose is out of the question, which leaves the mineral spirit denatured alcohol shellac the last choice lawfully in the field.

The committee received a gum substitute shellac made up in a fairly deodorized ether that made a strong bid for shop recognition, owing to the fact that the specialty would set up quick and sandpaper finish without tearing equal to any of pure raw shellac cut gum under test. The white and light orange shellac films exhibited represent the mineral spirit denatured alcohol cut shellac still further retarded to show that a quick spirit varnish can be made elastic enough to be taken off in film form.

ARE THERE SUITABLE SUBSTITUTES FOR TURPENTINE? IF SO, FOR WHAT PURPOSE MAY THEY BE USED?

BY C. F. MAYER
C., St. P., M. & O.

Oil or spirits of turpentine, commonly known as turpentine, is obtained chiefly from the long-leaf pine, though a portion is also obtained from Cuban and a little from Loblolly pine. The Forest Service has found that Loblolly, short-leaf and Virginia pines yield equal in quantity to the long-leaf yellow pines, and as the former occur in large quantities in the South their utilization adds largely to the turpentine resources of the country. The turpentine producing area in this country is practically confined to the coastal plains region of the Southern states. In the earlier days the industry was best developed in North Carolina, but, owing to the destructive methods of turpentine orcharding in conjunction with lumbering, fires, etc., the industry has gradually worked southward and westward until at present Florida produces the most turpentine, followed by Georgia, Alabama, Mississippi, Louisiana, North Carolina, South Carolina and Texas.

It is the trade practice to grade turpentine according to its color, and the various grades are known as "Water white," "Standard," "off one shade," "off two shades" and "off three shades." The latter is not merchantable. Under the trade regulations the deduction in price "off one shade" is 2½ cents per gallon, and "off two shades' 4 cents per gallon. Of late years, however, it has become customary to mix the colored turpentine with water-white or standard turpentine, adding a small quantity to each barrel. By this practice the producer receives more for his colored turpentine than he otherwise would under the trade regulations, and but one grade of turpentine is generally known to the buyer. There are, however, properties and methods of production decidedly different in the quality of various lots of turpentine. Recognizing this fact, many users of large quantities buy on definite and rather strict specifications, and it would probably be of advantage to the trade if several grades for turpentine were more generally recognized. The turpentine on the American market is quite frequently adulterated with cheaper and inferior oils, those most commonly employed being the petroleum oils having specific gravities corresponding closely to that of turpentine. Other adulterants are certain coal-tar oils, rosin spirits and wood turpentine which closely resemble turpentine in specific gravity and distilling temperature. Though it is known that spirits of turpentine is very frequently adulterated, to our knowledge no systematic investigation of the subject in this country is on record. The committee is of the opinion that this so claimed indispensable material is not always made on an honest, assured material standard, and is to some extent products of the spirits distilled from the strong poisonous, possibly tannic-charged, hemlock pine, saturated tarry pine tree stumps, pine shavings and sawdust. Odors have been invented in the laboratories so as to make some of the clever products so closely resembling that they can be sold as pure turpentine.

Owing to the extensive use of the various substitutes for turpentine, there should be no scarcity of turpentine. We have not been able to find statistics which show that the source from which turpentine is derived is becoming exhausted, although some people are of the opinion that turpentine will eventually disappear from the paint trade. Chemistry of the highest order is undoubtedly used in the production and commercialization of many of the new by-products, and the paint consumer can rest assured that there is no turpentine source thrown away today.

The committee finds that the only material value of turpentine is its solvent or evaporative powers where used in the painting process. Inasmuch as the turpentine evaporates

after the application of the paint, it ceases after the evaporation to have a material effect upon the character or durability of the paint. When mixed in paint, turpentine may be said to perform one particular service. It enables the painter to apply paint to surfaces with an amount of fixed oil or binding material present that would be too small to give fluid paint and produce the desired flat effect unless turpentine or some suitable substitute were present.

The test committee has made a number of substitute turpentine tests, which were mostly of the fixed or safe gravity mineral spirits order, also of one or two of the smelly coal-tar solvent kind, also some acid ethers. In testing the substitute turpentines, we found that their solvent power varied very much when coming in contact with the several makes of grinding japans we especially selected for test purposes, owing to the idea that the quality of the japan was more to blame for the average substitute turpentine failures than the substitute used. The japans used were a first-class standard make, graded as best shellac, good gum, and soft rosin made-up japans, the quality of each being first class. Of the nine substitute turpentines under test, four samples had solvent cutting power enough to cut the soft rosin japan with but little gum souring in the closed up bottles. The remaining five soured almost uniformly bad. Two out of the nine substitute samples soured badly in contact with the Kauri gum japan, the solvent power of the remaining seven samples only slightly clouded, which proved that the neutral mixing qualities of the Kauri japan were superior to the soft rosin japan. The hard shellac gum made japan neutrally mixed with the entire nine substitutes in a flawless manner, conclusively showing that if the grinding japan is made receptive the best of the mineral substitute turpentines could be exclusively used for all paint and japan color reducing out purposes in the railway car paint shop. If, when adopting the substitute turpentine, you find that it will do everything but clean out a lousy varnish brush, clean out your brush with varnish remover, which is much better and cheaper for the purpose as the cared for remover may be repeatedly used for brush cleaning.

The committee has also tried out five substitutes for turpentine against turpentine in a practical way for all purposes where turpentine is being used, such as fillers, stains, color varnish, flat leads, flat colors for exterior of passenger cars, etc. We find that these substitutes evaporate slower than turpentine, and colors mixed with them do not flat out as quickly as colors mixed with turpentine. They all, however, flat out equally as flat as turpentine, and we find that they are not so slow that it in any way delays the work. We have experienced no trouble in applying varnish over surfaces painted with color mixed with these substitutes. Varnish did not crawl or pit, and flowed out and dried equally as well as varnish that was applied over colors mixed with turpentine. We have been able to carry out the work with these substitutes successfully and apparently equally as well as with turpentine. What the final results from the use of these substitutes will be we are not prepared to say.

From our observations and tests, and from what we have been able to learn regarding the various substitute turpentines that are being placed on the market at the present time, most of them are petroleum products, and it is claimed by those who place them on the market that they are especially refined products absolutely free from grease, sulphur or other chemicals and are of the proper physical property necessary to take the place of turpentine. At one end of the series of petroleum we have gasoline, which evaporates very rapidly and is of no use practically in the preparation of paints. At the other end of the series we have products approaching kerosene, which evaporate so slowly that they also are useless in paints. Between these two extremes, however, it is claimed that there are a series of light petroleum oils which, if properly refined, are very useful in the preparation of paints. Many of these light petroleum oils, it is claimed, contain a small proportion of non-volatile oil which, if large enough in quantity, will have an injurious effect upon the paint made from them and the painting results obtained. In recent years, however, there has been a marked improvement in the manufacture of light petroleum oil, and it is claimed that some of them are exceedingly useful and produce with fair satisfaction the results which turpentine produces. From our investigation and tests of the various substitutes, we feel that there is a possibility of their being of value, either in place of turpentine or as an addition to turpentine, which at present prices would be a large saving in railway equipment painting. Before, however, the extensive use of substitutes is recommended we feel that it is a problem for the master painter to solve by practical test and results obtained therefrom.

The active paint craftsman should have no regrets at the passing of pure turpentine, as he, as well as the chemist or pharmacist, knows that the volatile gases thrown off from the purest turpentine are deadly poisonous to the human system; in fact, there is nothing more harmful to the confined indoor painter than breathing the pungent fumes thrown off from turpentine spirits. No doubt there is a wide difference of opinion on this subject among the master painters. Most of us have made tests of the various substitutes for turpentine, which have proved to be a complete failure. From our tests and experiments we are of the opinion that a vast improvement has been made in the refining of the products from which substitutes for turpentine are obtained, and the products of five, ten or fifteen years ago cannot be compared with those that are being placed on the market at the present time.

Discussion

W. O. Quest (P. & L. E.). You will find by looking over the samples that there are but two that show up well with the rosin japan, without getting gelatinous or souring. That was a revelation to me. That proved the contention that it might be the form of japan that we used. When we used the Kauri gum we had a little better average. Out of the nine, four of them behaved fairly well. The rest of them soured a little. When you come to the shellac, they are all clear. There was no gelatinous or souring effect. I am not making an issue out of this, but I have always been under the impression that when railroad companies buy what they call Q. D. colors, they should be ground in the best japan procurable. There should never be any cheap japan used; that is, for outside or engine work.

There is a difference in the solubility of the pure turpentine and substitutes, as a rule. In my experimenting I did not find one single substitute that did not have as much dissolving power as pure turpentine.

Another point that might be valuable to present was the coal tar preparations. Coal tar ethers have more solubility than anything we handled, and they could be used in quick drying colors. They get away as quickly as turpentine, and one or two a little quicker than any substitute we have.

It is of course not our object to try to manipulate any one kind of material. In regard to this japan, rosin japan is all right in connection with oil paint. There are few of us who haven't had trouble with putting a coat of paint on today that will lift up tomorrow when you put on another coat. It is nothing else in the world but the soluble japan that causes that. Take a japan that is made with some of your harder gum, and you can put two coats on in a day, and you would not dare to do that with gum of such solubility as rosin japan might develop into. I would not go on record as condemning rosin japan or Kauri japan, but we ought to have something that will dry hard for our body coats on coaches and locomotives.

J. R. Ayers (C. P. R. R.): I have had considerable ex-

perience for a good many years with various substitute turpentines. While I experienced trouble with certain brands, others I have used with entire success with japan colors. At the present time we are using fully 99 per cent of substitute turpentine with absolutely perfect results; we have not had any injurious effects. As far as thinning of oil paints is concerned, with the present rate we are using now, we are getting results equally as good as with pure turpentine. I know of one instance in which we had trouble with material that contained zinc, the substitute was a little higher in sulphur content than permissible to use, and I believe a great deal of the trouble the painters have experienced with substitute turpentine can be traced to the sulphur content of the substitute or the grinding of the japan, the colors which they tried to mix the substitute with.

Mr. D. C. Sherwood (N. Y. C.): We have had several experiences with substitute turpentine, also in the drying of our body colors and it would not dry as quickly as the pure turpentine and after being varnished it would be a different shade, but I feel we can use substitute turpentine, that is, if it is a very good grade. We have had some good and some bad. We can use it in surfacer. We have experienced no trouble at all in thinning down our surfacer, but I don't think we can get along without pure turpentine.

REPORT OF COMMITTEE ON SHOP CONSTRUCTION AND EQUIPMENT

The question of fully equipping a point shop to obtain efficiency, to yield a large output of locomotives, freight and passenger cars, and to insure better means of safety, is a broad matter to which attention of officials should be called. Many of the paint shops today, if equipped so as to represent one of a modernized type, would minimize the time now required for painting a car and would boost the output of finished cars or locomotives, thus making the shop function to its utmost capacity.

One essential part of the equipment that is not available in many shops is stationary scaffolding. Temporary scaffolds may prove to be satisfactory on small jobs or work that requires but little time, but speaking of a shop that has many cars to be turned out in a day, the stationary scaffolds are a necessity. They save many hours a day that could be used by the men in painting cars or locomotives. To move planks and trestles of the temporary type of scaffolds, three or four men have to stop other work. More accidents occur among the workmen who handle such apparatus.

The report is signed by: J. F. Gearhart (chairman), Pennsylvania; G. E. Grammer, Pullman Co.; A. J. Bishop, N. P.

REPORT OF COMMITTEE ON CLASSIFICATION OF PAINTING REPAIRS AND SHOPPING AND EQUIPMENT

The committee reported that the shopping of cars should be determined by the length of time in service or the general condition of car. As a general proposition the class of painting repairs should be determined by the paint foreman on arrival of cars at shops, and should receive treatment according to class of painting repairs, as follows:

SCHEDULE OF CLASS "A" REPAIRS
Steel Dining or Private Cars

Outside Operations—Body.

1st day—Sandblast and prime with standard primer.
2nd day—No operation (dry).
3rd day—1st coat of surfacer.
4th day—Putty and knife in pitted and uneven surface.
5th day—2nd coat of surfacer.
6th day—3rd coat of surfacer.
7th day—4th coat of surfacer (if necessary).
8th day—Rub with rubbing brick and water. (Guide coat previous to rubbing if desired).
9th day—Sand and touch up rubbed through spots, if any, with standard primer.
10th day—1st coat color.
11th day—2nd coat color.
12th day—Letter and 1st coat of finishing varnish.
13th day—No operation.
14th day—2nd coat of finishing varnish (flowed on as full as possible).

Roof and Deck.

1st day—Sandblast and prime with an approved pigment and oil primer Allow at least 48 hours to dry.
Paint roof with two coats of standard roof paint.
Paint deck with two coats of body color in oil or standard roof paint, according to Railway Company's standard practice.

Trucks, Platforms and Underneath Work.

Trucks, platforms and battery boxes, paint with one coat of an approved oil paint, followed by one coat of an approved truck enamel.
Underneath work, paint with two coats of an approved oil paint.

Inside Operations.

When necessary to remove paint and varnish:
1st day—Remove paint and varnish with an approved varnish remover.
2nd day—Prime with an approved primer.
3rd day—No operation (dry).
*4th day—1st coat of surfacer of an approved kind and shade.
5th day—Putty and knife in pitted and uneven surface.
6th day—2nd coat of surfacer, same as before.
7th day—3rd coat of surfacer, same as before.
8th day—Rub with rubbing brick and water.
9th day—Sand and touch up rubbed through spots, if any, with primer.
10th day—1st coat of ground color.
11th day—2nd coat of ground color, if surfacer is of desired color this operation may be omitted.
12th day—Grain.
13th day—Varnish.
14th day—Stripe, number and necessary notices applied.
15th day—Varnish.
16th day—No operation (dry).
17th day } Rub to produce standard finish as required by Railway
18th day } Company.

*Surfacer should be of a shade close to the graining ground color.

Head Lining Operations.

1st day—Prime.
2nd day—No operation (dry).
†3rd day—1st coat of surfacer.
4th day—Sand and 1st coat of enamel.
5th day—No operation (dry).
6th day—Finishing coat of enamel.
7th day—Stripe and ornament.

†If a stippled effect is desired, surface coat should be stippled and a preparatory coat used instead of the 1st coat of enamel, which also should be stippled.

Eighteen days consumed to finish this class of car, followed by two days for trimming, and O. K. on the 21st day.

SCHEDULE OF CLASS "A" REPAIRS
Steel Coach

The outside operations on a steel coach to be the same as those used on dining and private cars.

Inside Operation.

1st day—Remove paint and varnish with an approved varnish remover.
2nd day—Prime with an approved primer.
3rd day—No operation (dry).
4th day—1st coat surfacer of an approved kind and shade.
**5th day—Putty and knife all pitted and uneven surface.
6th day—Sand and 1st coat of enamel.
7th day—No operation (dry).
8th day—2nd coat of enamel.
9th day—Stripe and ornament, apply necessary notices and number of car with transfers.

**If Railway Company's standard requires graining, operations from hereon will be the same as with the dining car previously scheduled.

Head lining, roof and deck, trucks, platforms and underneath to receive same operations as those scheduled for dining and private cars.

Fourteen days consumed to finish this class of car, followed by two days for trimming, and O. K. on the 17th day.

SCHEDULE OF CLASS "A" REPAIRS
Steel Mail, Mail and Baggage and Baggage Cars

Outside Operations—Body.

1st day—Sandblast and prime with an approved primer.
2nd day—No operation (dry).
3rd day—1st coat of surfacer.
*4th day—Sand and 1st coat of body color in oil, or an oil enamel.
5th day—No operation (dry).
6th day—Finishing coat of body color in oil, or an oil enamel.
7th day—Letter.

*If Railway Company's standard will not permit of above appearance the schedule as applied to coaches, etc., can be applied here.

Roof and deck to receive same operation as those used on dining and private cars.

Trucks and underneath to receive same treatment as dining and private cars.

Inside Operations.

1st day—Prime with an approved primer.
2nd day—Putty.
3rd day—1st coat of an approved coating, standard shade.
4th day—No operation (dry).
5th day—Finishing coat of oil color or enamel, standard shade.
6th day—Paint steam coils and guards, and do necessary stenciling.

Note: The finishing coat for mail, and mail end of mail ang baggage cars, to be applied as per specifications issued by the United States Railway Mail Service. Seven days consumed to finish these classes of cars, followed by one day for trimming, and O. K. on the 9th day.

SCHEDULE OF CLASS "A" REPAIRS
Wood Dining or Private Cars

The outside operations on this class of cars to be the same as used on the steel type, with the exception that wood cars shall have the paint and varnish burned off.

If the Railway Company's standard does not require the block rubbed surface. Surfacer of the sanding variety should be substituted on the wood sheathed car, and sandpaper used to reduce surfacer instead of block rubbing with stone and water.

Roof and Deck.

Where canvas roof is applied:

Roof board joints to be properly leveled, etc., and primed with an approved pigment primer; the following day canvas to be applied in accordance with Railway Company's standard practice. Care should be taken to see that the back canvas is properly coated with an approved canvas roof protective coating and stretched and fastened in place while the coating is still wet, the outside of canvas should then be protected with three coats of an approved canvas roof protective coating.

Deck to receive three coats of body color in oil, or standard roof paint, according to Railway Company's standard practice.

When roof composition is applied that needs no painting, the deck to receive same treatment as stated above.

Trucks, platforms and underneath work to receive same treatment as applied to steel dining and private cars.

Inside Operation.

When necessary to remove paint and varnish with varnish remover:

1st day—Remove paint and varnish with an approved varnish remover.
2nd day—Sand and clean up by carpenters properly.
3rd day—Fill.
4th day—1st varnish.
5th day—Stripe, number and necessary notices applied.
6th day—2nd varnish.
7th day—No operation (dry).
8th day—3rd varnish.
9th day—No operation (dry).
10th and 11th days—Rub to produce standard finish as required by Railway Company.

Head lining to receive same treatment as applied to steel dining and private cars.

Fourteen days consumed to finish this class of car, followed by two days for trimming, and O. K. on the 17th day.

SCHEDULE OF CLASS "A" REPAIRS
Wood Coach

First-class coaches receive the same treatment accorded dining and private cars, with the exception of rubbing the inside with rotten stone.

SCHEDULE OF CLASS "A" REPAIRS
Wood Mail, Mail and Baggage and Baggage Cars

Outside Operations.

When necessary to burn off old paint, which should be very rare if body color in oil is used, the following operations to be applied:

1st day—Burn off paint.
2nd day—Sand and clean up by carpenters.
3rd day—Prime with an oil pigment primer.
4th day—Putty.
5th day—Coat with an elastic coating of desired shade.
6th day—No operation (dry).
7th day—Coat of body color in oil or oil enamel.
8th day—Letter.

Roof and deck to receive the same treatment as accorded wood coach.

Trucks, platforms and underneath work to receive same treatment as accorded wood coach.

Inside to receive same treatment as accorded steel type of this class of cars.

SCHEDULE OF CLASS "B" REPAIRS
Steel Dining or Private Cars

Outside Operations.

Car to be washed; after necessary repairs are made the following treatment to be accorded:

1st day—Prime new or bruised parts.
2nd day—Touch up parts with surfacer.
***3rd day—Putty and knife in parts.
4th day—Sand and 1st color.
5th day—2nd color.
6th day—Letter.
7th day—1st varnish.
8th day—No operation (dry).
9th day—Finishing coat of varnish flowed on as full as possible.

***If knifed in parts are large they should be rubbed out with block pumice stone and water; this will necessarily require an extra day in schedule.

Inside Operations.

1st day—Prime new or bruised parts.
2nd day—Touch up parts with surfacer of a shade close to the ground color.
3rd day—Putty and knife in parts; same should be of a shade close to ground color.
4th day—Sand and ground color parts.
5th day—Grain parts.
6th day—Varnish newly grained parts.
7th day—Varnish all over.
8th day—No operation (dry).
9th day—Rub to produce standard finish, as required by Railway Company.

Roof to receive two coats of standard roof paint.

Deck to receive two coats of body color in oil or standard roof paint, according to Railway Company's standard practice.

Trucks, platforms and battery boxes to receive one coat of enamel.

Underneath work to receive one coat of an approved oil paint.

Nine days consumed to finish this class of car, followed by two days for trimming, and O. K. on the 12th day.

SCHEDULE OF CLASS "B" REPAIRS
Steel Coach

The outside operations on a steel coach to be the same as those used on dining and private cars.

Inside Operations.

1st day—Prime new or bruised parts.
2nd day—Touch up parts with surfacer.
3rd day—Putty and knife in parts.
*4th day—Sand and touch up new or bruised parts with enamel.
5th day—No operation (dry).
6th day—Enamel body and head lining.
7th day—Stripe head lining, apply number and necessary notices with transfers.

*If interior is to be grained all bruised parts will have to be given proper ground coat, grained, etc.

Roof to receive two coats of standard roof paint.

Deck to receive two coats of body color in oil, or standard roof paint, according to Railway Company's standard practice.

Trucks, battery boxes and underneath work, one coat of an approved oil paint.

Platforms, one coat of enamel.

Nine days consumed to finish this class of car, followed by two days for trimming, and O. K. on the 12th day.

SCHEDULE OF CLASS "B" REPAIR.
Steel or Wood Mail, Mail and Baggage, and Baggage Cars

After car is washed and necessary repairs made, the following treatment to be accorded:

1st day—New or bruised parts touched up with body color in oil, or an approved primer.
2nd day—Putty.
*3rd day—Sand and 1st coat of body color in oil, or an oil enamel.
4th day—No operation (dry).
5th day—Coat of body color in oil or an oil enamel.
6th day—Letter.

*If Railway Company's standard will not permit of above appearance the schedule as applies to coaches, etc., can be applied here.

Roof to receive two coats of standard roof paint.

Deck to receive two coats of body color in oil or standard roof paint, according to Railway Company's standard practice.

Trucks, battery boxes and underneath work, one coat of an approved oil paint.

Inside Operations.

1st day—New or bruised parts touched up with color or an approved primer.
2nd day—Putty.
3rd day—1st coat of an approved coating, standard shade.
4th day—No operation (dry).
5th day—Finishing coat of color or enamel, standard shade.
6th day—Paint steam coil and guards and do necessary stenciling.

Six days to be consumed to finish this class of car, followed by one day for trimming, and O. K. on the 8th day.

CLASS "C" REPAIRS
Steel or Wood Dining or Private Cars and Coaches

Car to be washed.

After necessary repairs are made the following treatment to be accorded:

Outside of car, new or bruised parts touched up with primer and surfacer, puttied, sandpapered, spot colored and given a coat of color all over, cutting in around lettering, numbering, etc.

Apply one or two coats of varnish according to Railway Company's standard.

Roof to receive one or two coats of standard roof paint.

Deck to receive one or two coats of body color in oil, or standard roof paint, according to Railway Company's standard practice.

Trucks, battery boxes and underneath work, one coat of an approved oil paint.

Platforms, one coat of enamel.

Inside Operations.

If wood, touched up and given only sufficient operations to make presentable and maintain Railway Company's standard.

If steel, touched up and given only sufficient operations to make presentable and maintain Railway Company's standard.

Six days consumed to finish this class of cars, followed by one day for trimming, and O. K. on the 8th day.

We would recommend that cars having received Class "A" repairs be returned to the shops to receive Class "C" repairs after service of twelve months.

Cars receiving Class "B" or "C" repairs should be returned to the shops at the expiration of 18 months.

This report is signed by: D. C. Sherwood, N. Y. C.; A. E. Green, C. & N. W.; J. R. Ayers, C. P.

REPORT OF COMMITTEE ON SAFETY AND SANITATION

The safety devices in and around railway paint shops is a matter that should interest and attract the co-operation of every man employed. While it is not usually considered a hazardous occupation, nevertheless certain elements of danger enter into the trade and should be carefully checked and, in so far as possible, eliminated.

The scaffolding in our modern shops should be so constructed as to guard against any possibility of collapse; and if mechanical in action, certain absolute devices should be attached to make them sure and safe. All fires, such as open torches or portable furnaces, should be excluded from the paint shop, for the nature of the materials used are of volatile and spontaneous mixtures and easily ignited. Nearly every paint shop fire has been directly traceable to this source.

The protection of employees when working on cars in repair yards is important, and the tracks should be equipped with caution signs of an absolute character. If possible, switches leading to repair tracks should be locked and a

blue flag displayed reading "REPAIR MEN." These flags should not be removed except by those directly in charge of the gangs who are doing the work. Each man should be instructed to see to it that such protection is in place before proceeding with his work. Most railroads make this rule imperative when employing men.

Workmen who are asked to clean and scrape rust off of steel cars should be furnished with goggles for eye protection. Chain hoists used for handling and unloading barrels, etc., should receive frequent inspection. Stepping on nails is very frequent and sometimes results in serious consequences; it is therefore very essential that rubbish of all kinds be removed and deposited in receptacles specially provided for this purpose.

Sanitation

Sanitation of shops and surroundings is one of the most paramount features necessary to establish an efficient organization. Nothing so impairs the efficiency of men as unhealthy surroundings. Very frequently better places are discarded or left vacant than buildings erected for men to work in. The purpose of this report is to point out some few conditions which would tend to weaken an organized body of men and thus lessen their efficiency, and suggest a few more favorable conditions which would tend to build up a healthy, happy and efficient group of workmen.

The buildings, in so far as possible, should be made and placed so as to guard against unsanitary conditions, furnished with good sewage, plenty of air spaces, well ventilated and sufficient heat units to keep the temperature even. Doors and windows should be so placed as to guard against insufficient circulation of fresh air at all times. If possible, all openings should be screened in order to keep out the dreaded germ carriers. Floors should be so constructed that water will drain off, thus preventing a possibility of breeding places for mosquitoes, etc. A room measuring 18 ft. by 24 ft., making a floor area of 432 sq. ft., should contain four windows measuring 3 ft. by 6 ft., a total window area of 72 sq. ft. Natural illumination is that provided by the direct rays of the sun or light reflected by the sky. In factories, workshops and other places in cities where daylight illumination is reduced by the walls of neighboring buildings, an increased illumination may be obtained by the use of ribbed glass, which causes a larger portion of the light to be refracted into the building. Windows should always be kept clean, as the amount of light entering the room may be reduced 40 per cent by dirt upon the glass. With modern illuminating units and suitable reflectors a current consumption of about one watt to each square foot of surface should yield an intensity of four-foot candles. Every effort should be made to prevent a glare, as glare makes seeing difficult and soon impairs the eyesight, thus further interfering with the efficiency of the workmen.

Dust is the arch enemy of the paint-shop workman. It may be of organic or inorganic origin. The inorganic dust is what is most dangerous, and we must guard our workmen against the dust from the sand-blast machine. For dust from this source is severe on the throat and lung tissues. There are numerous ways to accomplish this. Somerfeld, in the following table, gives some idea of the injurious effects and the death rates per thousand from consumption of persons engaged in various trades where dust is a prominent factor:

Occupation without dust production	2.39
With dust production	5.42
With porcelain dust	14.
With iron dust	5.55
With lead dust	7.79
With stone dust	34.09
With stone workers	4.03
With wood and paper dust	5.96
With tobacco dust	8.47

Dust containing sharp, gritty particles, such as present during cutting of hard rock, sets up a chronic irritation of the air passages which then become favorable lodging places for the germs of consumption and kindred diseases. The bad effects of dusty working places may be obviated by the use of respirators. These are, however, rather uncomfortable to wear, so the better way is to remove the dust at its source by some mechanical device or prevent its accumulation in the air by the use of water.

Those who are compelled to work in white lead should use great precaution regarding cleanliness. A workman should never eat or handle food without first thoroughly cleansing his hands, for lead is more often carried into the system through this process than in any other way. Lead poisoning has become so great a menace among workmen that the State Boards of Health and Labor Bureaus are making a very exhaustive examination of the causes and prescribing ways and means of averting its ravages.

Painters stenciling cars where it is necessary to hold the stencils with the fingers should use some form of protection. The use of finger ends from rubber gloves is a simple and effective expedient. Dr. Robert Jones, reporting in 1900 upon 3,500 males admitted to the London county asylum for the insane, found among them 133 artisans who had been exposed to plumbism; painters, 75; decorators, 13; plumbers, 18; gasfitters, 13; laborers in lead, 6; grainers, 3; gas meter makers, 2; color grinders, 1; file cutters, 1, and tea lead rollers, 1. It seems that whatever we can do to allay the possibility of lead poisoning should, by all means, be done.

There are only two ways to come in contact with paint and its effect on the health of men: by actual physical contact, and by inhalation; and both of these can be almost entirely eliminated, one by the painter himself and the other by shop construction. The careful painter will always avoid getting paint all over his hands and face, and we should see to it that the other, ventilation, is given him.

Paint Spraying Machines

The spraying machine is one of the most economical and efficient means of applying paint to all freight cars, running parts of locomotives, trucks and underframes of passenger cars. It is the experience of the committee that a freight car can be painted at about one-fourth the cost for labor by use of a spraying machine. The cost of labor saved is not the only item to be considered. Freight cars can not be painted until after repairs are completed, and to maintain a force of painters of sufficient size to paint cars by hand after cars are repaired would mean that during a large part of the day these painters would be idle. By using spraying machines a small force of painters can do the work and can be profitably employed during the early part of the day at necessary small jobs.

Since the spraying machine is both economical and efficient, we should use all means to overcome the only possible objection to it, make its use free from fume effect. We would suggest that all work be done out of doors as much as possible. Freight cars can be and usually are painted under a shed, and many shops do not even have a shed. The next thing is to use a spraying machine with a long barrel or "gun" that not only makes the use of scaffolds unnecessary but puts the paint up close to the work and away from the operator.

The report is signed by: W. A. Buchanan (chairman), D., L. & W.; J. S. Gilmer, Southern; C. D. Beyer, L. & N.

Machinery Exports Treble in Six Years.—In 1913 the total exports of machinery were valued at $127,980,000, while in 1919 they reached a total value of $378,425,000. That the total in the latter year was not greater was due to the urgent home demands for machinery of almost every description, which limited the amount available for export. One large manufacturer declared recently that his foreign orders for the first six months of the present year were more than 60 per cent greater than during the same period last year.—*The World Markets.*

Banquet of the Tool Foremen's Association

Convention of the Tool Foremen's Association

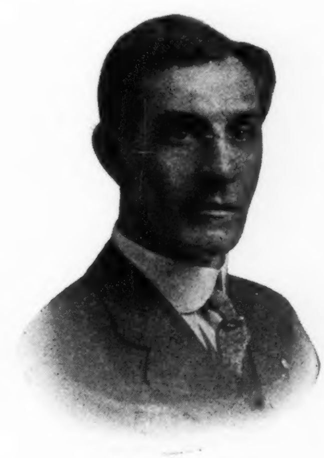
Standard Staybolt and Boiler Taps Agreed Upon; Proposal to Amalgamate With A. R. A. Sec. III Adopted

THE American Railway Tool Foremen's Association is the second of the so-called minor mechanical department organizations to take definite action on the question of amalgamation with the American Railroad Association, Section III—Mechanical. The Association voted definitely to accept the invitation of Section III—Mechanical to become a part of that organization, at the tenth annual convention, which was held at the Hotel Sherman, Chicago, September 1, 2 and 3.

J. C. Bevelle
President

J. B. Hasty
First Vice-President

G. W. Smith
Second Vice-President



R. D. Fletcher
Secretary-Treasurer

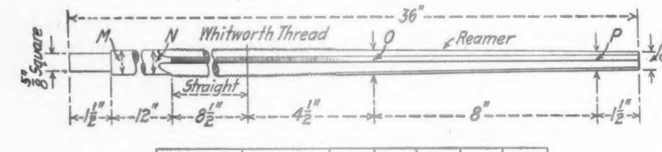
The convention was called to order by the president, J. C. Bevelle (El Paso & Southwestern) and, following the usual opening exercises, proceeded immediately to the consideration of the technical reports and papers on the subjects assigned for investigation at the last convention. Abstracts of the papers and the discussion which took place at the meeting are given below.

STANDARDIZATION OF BOILER AND STAYBOLT TAPS

Fig. 1 shows a 36-in. tap with Whitworth threads, 12 per in., which is carried by tap manufacturers throughout the United States in regular stock. There is also made, to the same standard, spindle tap and spindle which is used for the same purpose as the 36-in. tap. This tap, known as style two, has been used to good advantage for applying staybolts back of the frame. These taps are 12-thread Whitworth and are manufactured by the S. W. Card & Company, or by Charles Besly & Company. Our reason for recommending the adoption of these taps is the fact that they are at present used successfully on many railroads and are giving better results than other types. The Whitworth thread has a greater tensile strength and maintains its original

diameter longer than the V or the United States Standard forms of thread.

A standard 24-in. staybolt tap is also required. This tap is also 12-thread Whitworth. These taps are at present carried in commercial lengths of 21 in., 22 in. and 24 in. We recommend the 24-in. tap because the reamer portion is extra long, giving a greater length and smaller diameter on the point, so that, when tapping from the outside, the small end of the tap protrudes through the inside sheet and acts as a guide, making it much easier for the operator and assuring a good thread on both the outer and inner sheets. The taper threaded portion of the tap has been lengthened,



Size of Tap	Threads to inch	M	N	O	P	Q
15/16"	12	13/16"	15/16"	13/16"	11/16"	5/8"
1"	12	7/8"	1"	7/8"	3/4"	11/16"
1 1/16"	12	15/16"	1 1/16"	15/16"	13/16"	3/4"
1 1/8"	12	1"	1 1/8"	1"	7/8"	13/16"
1 3/16"	12	1 1/16"	1 3/16"	1 1/16"	15/16"	7/8"
1 1/4"	12	1 1/8"	1 1/4"	1 1/8"	1"	15/16"
1 5/16"	12	1 3/16"	1 5/16"	1 3/16"	1 1/16"	1"

Fig. 1—Radial Staybolt Tap

making the life of the tap much longer as well as eliminating a great deal of wear and tear on the air motor and consequently making it easier on the operator. We recommend that these taps be furnished in sizes from 15/16 in. to 1-5/16 in., advancing by sixteenths if possible. We find that these sizes will conform to the government rulings, making 15/16 in. the smallest bolts and 1-5/16 in. the largest. These taps are all to be 12-thread Whitworth and should be furnished over-size with a minimum of .0015 in. and not to exceed .0035 in. This will take all standard makes. The number of threads per inch should be 12 and in a distance of 6 in. there should not be more than 60¼ threads or be less than 59¾. The staybolt cutting machine should be checked very closely and the diameter kept to a standard so that the threads cut on the staybolt will be as accurate as the tap.

Fig. 2 shows a standard button head radial staybolt tap.

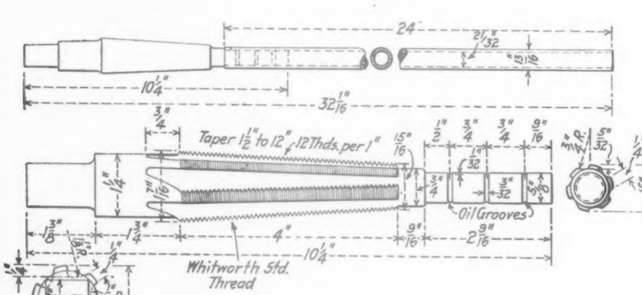
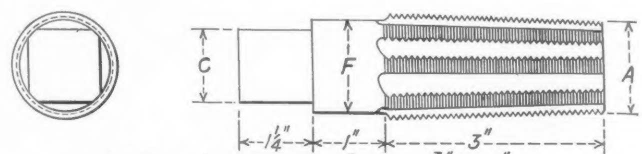


Fig. 2—Button Head Radial Staybolt Taps

This tap is now commercially manufactured and is used very successfully on many railroads. It has a taper of 1½ in. in 12 in. and is 12-thread Whitworth. This tap is used for applying button head radial staybolts in the crown sheets of locomotives.

Fig. 3 shows boiler head and washout plug taps. These taps should be tapered ¾ in. in 12 in. and have 12 threads per inch, United States Standard. One taper and one thread should be maintained in all washout and mud plug holes. It has been found that taps made with this taper give excellent results, not only assuring a good tight plug, but one that is safe. We find that ¾-in. taper in 12 in. is far more desirable than 1½ in. and believe that it will eliminate the blowing out of washout plugs.

Fig 4, shows a special washout or mud plug tap. This is only used in emergencies or in roundhouse service where it



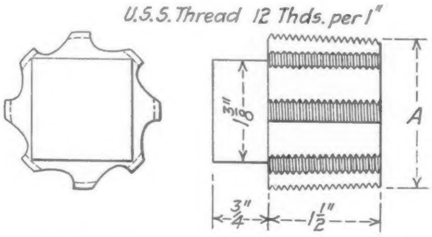
U.S.S. Thread 12 Thds. per 1" Taper 3/4" in 12"

No.	A	C	F	Flutes	No.	A	C	F	Flutes
10	1 1/4"	1"	1 3/16"	5	24	3"	2"	2 7/8"	8
11	1 3/8"	1"	1 3/16"	5	25	3 1/8"	2"	2 7/8"	8
12	1 1/2"	1"	1 1/4"	5	26	3 1/4"	2"	2 7/8"	8
13	1 5/8"	1"	1 1/4"	5	27	3 3/8"	2"	2 7/8"	8
14	1 3/4"	1"	1 3/8"	5	28	3 1/2"	2 1/4"	3 1/4"	8
15	1 7/8"	1"	1 1/2"	6	29	3 5/8"	2 1/4"	3 1/4"	10
16	2"	1 3/8"	1 7/8"	6	30	3 3/4"	2 1/4"	3 1/4"	10
17	2 1/8"	1 3/8"	1 7/8"	6	31	3 7/8"	2 1/4"	3 1/4"	10
18	2 1/4"	1 3/8"	1 7/8"	6	32	4"	2 1/4"	3 1/4"	10
19	2 3/8"	1 3/8"	1 7/8"	6	33	4 1/8"	2 1/2"	3 5/8"	10
20	2 1/2"	1 3/8"	1 7/8"	8	34	4 1/4"	2 1/2"	3 5/8"	10
21	2 5/8"	1 3/8"	2 1/4"	8	35	4 3/8"	2 1/2"	3 5/8"	10
22	2 3/4"	1 3/8"	2 1/4"	8	36	4 1/2"	2 1/2"	3 5/8"	10
23	2 7/8"	1 3/8"	2 1/4"	8					

Fig. 3—Boiler Head and Washout Plug Tap

is not possible to insert a standard length tap. These taps conform to the standard tap with the exception that they are not as long. Fig. 5 shows boiler stud and patch bolt taps. These taps have ¾ in. taper in 12 in., United States Standard form of threads, and run in such sizes that one tap will fol-

U.S.S. Thread 12 Thds. per 1"



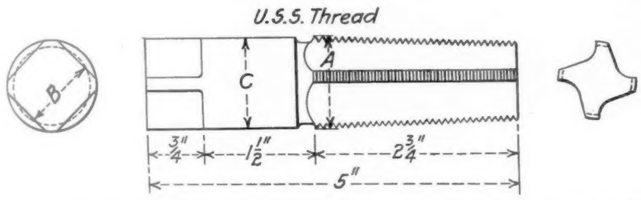
No.	Diam. at A	Taper	Where Used	Remarks
1	2"	3/4" in 12"	Corner Plug back of Frame	
2	2 1/8"	" "	" "	
3	2 1/4"	" "	" "	
4	2 3/8"	" "	" "	

Fig. 4—Special Washout Plug Tap

low the other, the sizes being designated on the large end. The taper tap is recommended instead of the straight tap for boiler studs for the following reasons: First, we can get a more secure stud with the taper thread tap than with the straight thread tap; second, there is less liability of a leaky stud. It must be understood that when taper studs are applied they must penetrate the sheet. It is now the practice on many railroads to use a tap similar to the one described.

If these taps are adopted as standard they will eliminate

many irregularities that now exist on the railroads throughout the United States. Furthermore, it simplifies the manufacturing of taps for this particular class of service. At present these taps can be secured from any first-class manufacturer at a much more reasonable price than they can be manufactured locally in a railroad shop.



No.	Threads Per Inch	Taper in 12"	A	B	C
A	12	3/4"	7/16"	7/16"	1/2"
B	12	3/4"	9/16"	1/2"	5/8"
C	12	3/4"	5/8"	1/2"	5/8"
D	12	3/4"	11/16"	1/2"	5/8"
E	12	3/4"	3/4"	1/2"	3/4"
F	12	3/4"	13/16"	1/2	3/4"
G	12	3/4"	7/8"	3/4"	7/8"
H	12	3/4"	15/16"	3/4"	15/16"
I	12	3/4"	1"	3/4"	15/16"
J	12	3/4"	1 1/16"	3/4"	1"
K	12	3/4"	1 1/8"	3/4"	1"
L	12	3/4"	1 3/16"	3/4"	1"

Fig. 5—Standard Patch Bolt Tap

The report was signed by E. J. McKernan (chairman) W. Wood, W. Perkins, J. N. Meek and H. E. Barnes.

Discussion

The question of what type of thread for staybolt taps will give the best results brought out a general discussion. The comments of the members indicated that comparatively few railroads have adopted the Whitworth thread recommended by the committee, while about an equal number appeared to be using the V thread and the United States Standard thread. Expressing their personal opinions, however, few of the members considered V threads as satisfactory as either of the other two kinds and the prevailing sentiment indicated that the Whitworth is the most desirable of the three types. Tests were referred to in which the pulling strength of the Whitworth type in the sheet has been demonstrated to be greater than either of the other two forms and the circular shape of the cutting edges of the Whitworth tap is less affected by wear than either of the other two, both of which have sharp corners. Taps with the V thread have been found to lose as much as .003 in. in diameter in tapping one hole under the heavy drive which these taps must withstand under modern conditions. Where a railroad makes its own taps, however, which is frequently done in the case of the plug and stud taps, either the United States Standard or the V type threads are more easily formed. For this reason the committee recommended the United States Standard type for plugs and stud taps.

HEAT TREATMENT OF STEELS

Heat treatment is the most important operation that our tools have to pass through. Shop output depends very largely on the quality and quantity of small tools. To get maximum shop output every tool and machine must be giving maximum production, which means that it is completing its operation in the shortest possible time and is keeping this up for a maximum period of time. These two factors are dependent one upon the other. If we operate a machine at too high speed or too great a depth of cut, resulting in excessive wear or breakage, the time consumed in changing, re-setting or repairing overbalances the time gained by the increase of speed or depth of cut.

The moral effect on the men in the shop of properly heat treated tools goes farther toward getting a maximum shop output than any of us can imagine. It is a factor which cannot be expressed very easily by figures. We have absolute control over the design of the tool, but can we say what its performance will be after it has been treated and ground up ready to put in service? If we have the proper equipment we can say yes for a very large per cent of our tools.

To obtain the best possible results from the heat treating plant there should be a spirit of close co-operation between it and the department using the tools. In other words, the one in charge should have a thorough knowledge of their performance in service. The best way for this condition to exist is for the tool foreman to have actual charge of the treating plant. This has been done in a great many shops. The heat treating plant should be in the manufacturing department, which would reduce the lost motion and the overhead charges in transporting tools to and from the heat treating furnaces.

HEAT TREATMENT

Owing to the general makeup or composition of tool steel, which is unlike pure iron or other similar metals, it must be properly and carefully handled in the heat treatment to obtain best results and prevent losses.

There are three general heat treatment operations: annealing, hardening, and tempering. In all of these the object sought is to change in some manner the existing properties of steel; in other words, to produce in it certain permanent conditions.

The controlling factor in all heat treatment is temperature. Insufficient or excessive temperatures do not produce the results sought. Excessive temperatures, either through ignorance of what the correct point is or inability to tell when it exists, may cause burned steel. This is a common failing, resulting in great loss. Slight variations from the proper temperature may do irreparable damage. Steel that has been burned is useless and cannot be restored by annealing.

In the actual heating of a piece of steel several requirements are essential to good hardening. First, the small projections or cutting edges must not be heated more rapidly than is the body of the piece; second, all parts must be heated to the same temperature, as low as will give the required hardness to produce the best results.

Any temperature above the "critical point" of steel tends to open its grain, to make it coarse and to diminish its strength. The temperatures at which the internal changes in structure of steel take place are frequently spoken of as the "critical" points. These are different in steels of different carbon contents. The critical points may be observed by watching closely the slow heating of a piece of steel in the furnace. At first the temperature of the steel gradually increases with the heat of the furnace until a point is reached at which it appears a little darker and cooler than the furnace, then as heating continues the piece again assumes the color and temperature of the furnace. This critical point is termed "decalescence." A similar change may be noted in cooling down the furnace, during which process at some point the piece of steel may become brighter and apparently hotter than the furnace, and later assume again the temperature of the furnace. This is known as the "recalescence" point. The temperatures of the critical points are usually dependent on the percentage of carbon.

Great care should be exercised in heating tool steel for forging as well as hardening or tempering; this is especially

true of high speed steel. Take sufficient time, depending on the size of the piece, to give it a thorough soaking heat, up to the proper temperature, but do not overheat.

The exact treatment varies for different steels and it is usually advisable to follow the directions given by the steel makers.

METHODS AND EQUIPMENT FOR HARDENING AND TEMPERING

It has not been long since heat treating as well as forging and dressing tools was entirely handled in the blacksmith shop by old methods. Results depended on the ability of the tool smith and the attendant varying conditions. The principal factor, temperature, was governed by observation of the color both when hardening and drawing. Today most of the railroads are using up-to-date methods and equipment, especially in their large shops, where centralized manufacture of tools is carried on.

Unquestionably the proper location for heat treatment of tools at shops where any considerable amount of this work is done, is in the tool room. It is important that, in order to handle this work successfully, the men in charge have a knowledge of the material and proper methods of handling, and be provided with the suitable equipment, such as furnaces, heat gaging apparatus, hardness testing instruments and so forth.

There are several types of furnaces which may be used for heating tool steel and the kind selected would depend considerably on the shop conditions and the kind of fuel available. Good results are obtained from furnaces using electricity, gas, oil or hard fuel, such as coke or coal, as heating mediums; the first two mentioned are no doubt the most popular and efficient for tool work. Any fuel-burning furnace for this work should be so constructed that the flame does not come directly in contact with the article to be hardened. This can easily be arranged through use of a combustion chamber in connection with suitable design and construction of the heating chamber. There are several different designs which may be used for each of the different fuels, but they all should produce as nearly as possible the ideal condition for the heating chamber where the work is placed. The size will be governed by the amount and size of the articles to be hardened.

Some of the best builders of furnaces today are prepared to furnish very desirable equipment, either standard or built to specifications, and there is available complete matter in the way of description and prints on both the electric furnaces and those using other fuels, so we will not take space here to describe each in detail.

The nature of the work, the size or shape of piece to be hardened, makes desirable at times the use of different processes or kinds of heating mediums, as, in addition to the plain electric, gas, oil or coke oven, the bath furnace is found very convenient for long articles, such as stay bolt taps, long reamers, etc. The material used for the bath usually is lead, or a salt mixture, such as barium chloride, etc., each having some advantage over the other. This form of hardening is much in favor for a lot of work done in the tool room, on account of the ability to heat only that portion of the tool desired, and exclude all air from the heated part, thereby eliminating danger of scaling, which exists with almost any other means of heating.

The quenching of the heated article is an important operation and in too many cases is not given the consideration and attention it should receive. The tanks should be of ample size and it is often necessary, if much work is done, to have more than one in order that the quenching liquid may be maintained at an even temperature. The uniform hardening of heating tools depends greatly on the uniform temperature of the quenching mixture and, where one tank or more is used, a good arrangement is to have the quenching tank inside of another tank of water and to keep the quenching medium stirred up by air through a submerged pipe or by mechanical means. Oils, brine and clear water are used as quenching mediums, and the temperature may be raised or lowered as desired by means of steam or water pipes, but it should be kept uniform for each batch of tools and for all similar work.

In the hardening operation the steel should be quenched on the rising temperature.

The use of air for hardening high speed steel is also necessary in addition to the liquid and it is best to have a good valve in connection with a compressed air line to regulate the pressure.

Hardening and Tempering Room, Illinois Central, Burnside Shops, Chicago

For some time past the oil bath has been generally used for drawing back and it is preferable to the old way of drawing by observing the color of the tool. There is also in use for this purpose the electric oven, which is comparatively new and in several ways superior to other equipment for this work.

TEMPERATURE MEASUREMENT

In all the heat treatments of steel, and especially the heating of tool steel for forging, hardening or drawing, the most valuable asset of the hardener is the knowledge of proper temperatures for the various kinds of steel and a sure and convenient means of determining those temperatures. The information regarding the proper temperature for a certain kind of steel is easily obtained and it is considered good practice to follow the instructions of the steel manufacturer for his product. The only safe way to measure or determine the temperature in the future or bath is by the use of good electrical or optical pyrometers. The practice of depending upon the naked eye to tell the temperature of a furnace or a tool by its color is not productive of good results, no matter what kind or how good the steel may be.

Pyrometers may be used in connection with almost any kind of furnaces and it is well to have a master pyrometer for comparison in checking the service instrument. These are not complicated nor expensive devices when compared with the service they render. They are, however, somewhat delicate and should be handled accordingly. The pyrometer may be tested for correctness by the simple salt-cooling process, or will be calibrated by the manufacturer or by the United States Bureau of Standards for a nominal sum. The pyrometer must be kept accurate at all times, as variation either way of several degrees would render it as good as useless for temperature determination; therefore, check your instrument frequently.

HARDNESS MEASUREMENT

There is still another instrument which, by all means, should have its place in the complement of equipment for heat treatment of tool steel. This is the scleroscope. There are other methods of testing the hardness, which no doubt are equally as good for some kinds of work, but the scleroscope seems to be best suited for tool room use. There should be a record kept of the heat treatment of all tools made. This may best be in the form of a card record for ready reference and should contain such information as kind of tool, make and grade of steel, temperature given for hardening, time in furnace, quenching medium used, drawing temperature and time, and scleroscope hardness. To this may be added remarks relating to the performance of the tools in service.

This will be very valuable information for the tool man. It will enable him to make corrections from time to time in the treatment of steel, or of defects which may be a result of having it too hard or too soft for the purpose for which the tool is used. The report was signed by C. A. Shaffer (chairman), H. Otto, P. Renfrew, W. J. Hines and F. C. Courson.

Discussion

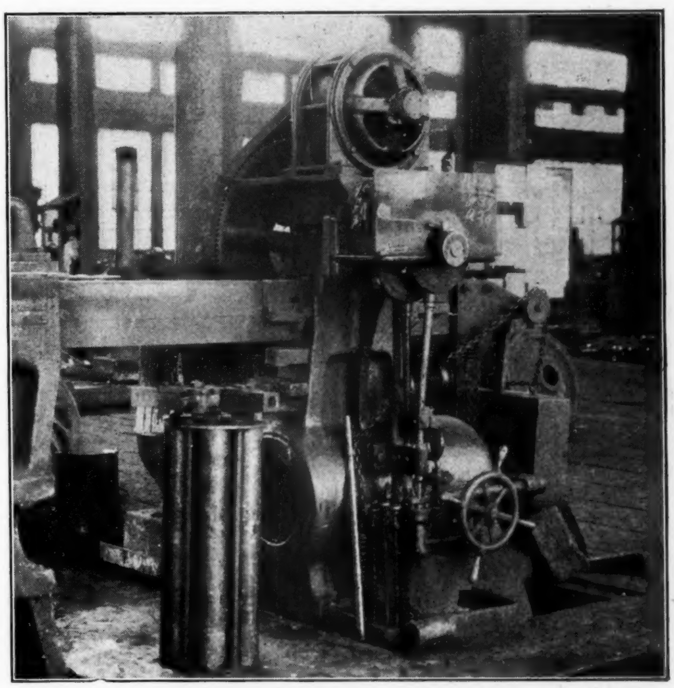
During the discussion, Professor Kinsey, of Stevens Institute of Technology, Hoboken, N. J., gave an interesting talk on the principles of heat treatment of steel, bringing out clearly why uniform results cannot be expected from tools which are heat treated in the open fire of the blacksmith's shop and the eye depended on to measure temperature by color determination. Professor Kinsey pointed out that the transformation which causes hardness on quenching takes place at the decalescent point, which occurs within the narrow range of about 54 deg. If this temperature is not reached the complete transformation will have not taken place, while, on the other hand, if this temperature is exceeded a change takes place which immediately begins to increase the grain size thereby seriously weakening the material. He pointed out the practical impossibility of accurately determining temperature within this narrow limit by color determination, which is effected by changes in the light of the shop.

The fact that there are not as many skilled toolsmiths at the present time as used to be employed in the blacksmith shop was mentioned as an additional reason why suitable furnace equipment fitted with pyrometers is more essential now than ever before if satisfactory tool service is to be obtained. Where this work is specialized it is not essentially a blacksmith's job, as a good heat treater need know nothing about the details of the blacksmith trade.

The importance of careful attention to furnace conditions was also touched on from several different angles. Several cases were mentioned where failure to secure proper hardness was experienced, for which there seem to be no apparent cause. The discussions indicated that these cases are frequently due to carbonization of the surface of the material cause by the flame playing on the tools. This frequently insulates the material, thus preventing a uniform temperature being attained throughout the piece. Similar results have been caused by oxidization or de-carbonization of the surface, thus producing a soft exterior which can only be corrected by removing the surface metal and rehardening under proper conditions. Burned steel has also been found to be more the result of improper furnace conditions than of the actual temperature to which the material has been heated. If oxidization can be prevented the temperature has little effect on steel which cannot be removed by annealing and retreating.

JIGS AND DEVICES FOR LOCOMOTIVE AND CAR SHOPS

At the Roanoke, Va., shops of the Norfolk & Western, a 300-ton wheel press, with 13-in. ram, unexpectedly developed a bad place in the copper lining and a new liner had

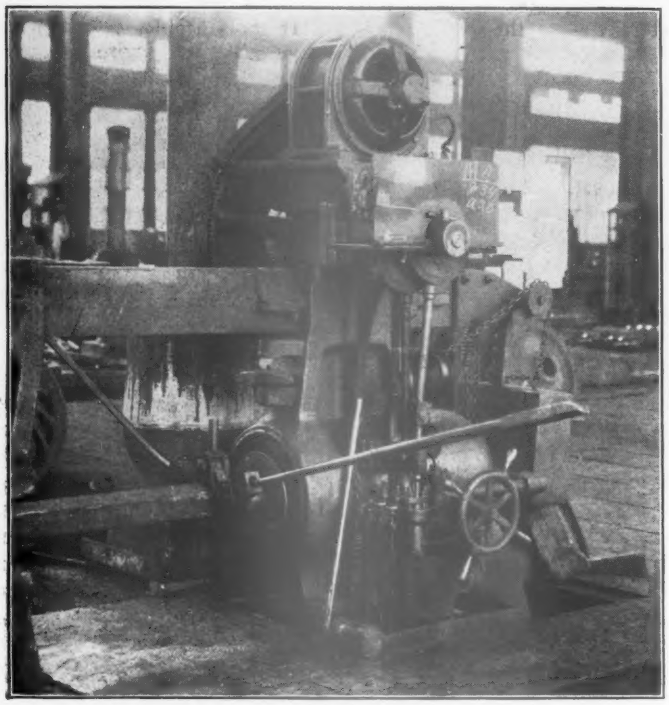


Rollers for Applying Copper Lining to Wheel Press Cylinders

to be rolled in place at once. The part of the press to be worked on was brought to the machine shop and placed on the table of the locomotive cylinder boring machine and

rollers with 2-in. faces were placed in the tool slots of the boring head, with a taper pin in the center to expand the rolls uniformly.

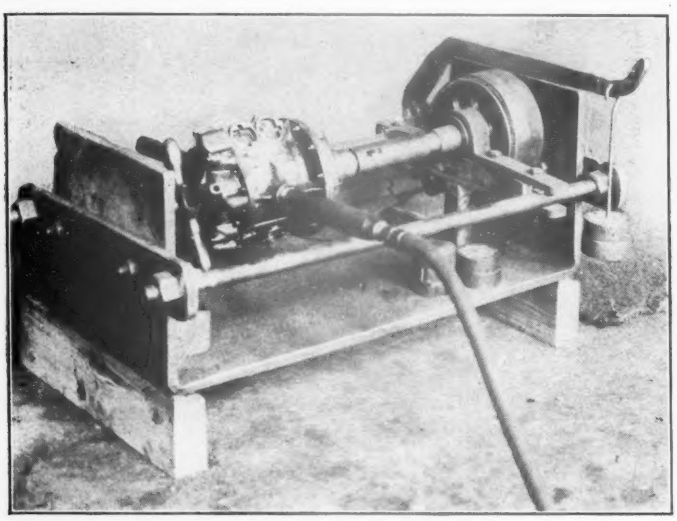
The work proceeded nicely while feeding in on the first rolling, but on feeding out it was discovered that the liner was stretching and moving out and, when complete, the job was not as satisfactory as could have been desired, due to the



Method of Operating the Rollers

creeping of the material as the rolls passed over the surface.

As a result of this experience a roller was made having five rolls, 4½ in. in diameter at the large end and extending into the cylinder 31 in., the entire depth of the copper liner, with a taper of ⅛ in. in 12 in. A taper pin of sufficient



Prony Brake Used for Testing Air Drills

diameter to expand the rolls the required amount was operated by a ratchet lever and bar, and forced between the rolls with the aid of the twin ram at the other end of the press.

With this device the liner was rolled into place in a very satisfactory manner by simply removing the ram and the old copper liner and inserting the new liner and putting the roller in service. The work was finished in perfect condition and ready for service in five hours.

TESTING PNEUMATIC DRILLS FOR PULLING POWER

When a pneumatic drill has been sent to the shop for overhauling, there should be some method of determining whether it has been improved by the operation and what per cent of its normal power it is exerting. In order that the machines could be checked before leaving the shop the ap-

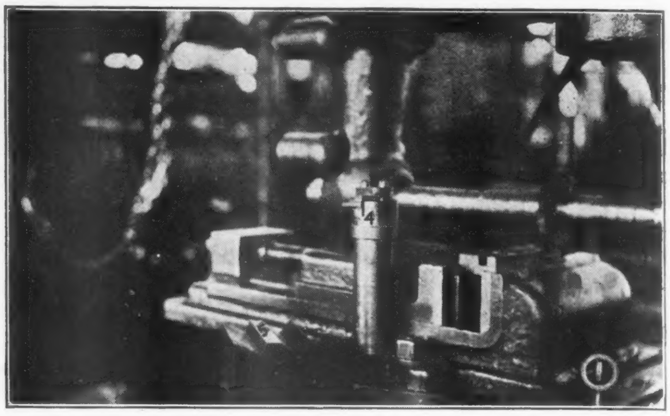


Fig. 1—Milling the Grooves in Flue Cutter Knives

paratus shown in the photograph was designed for use at the Roanoke shops of the Norfolk & Western.

It consists of a spindle and brake wheel in a frame, to which the drill can be attached in the manner and with the same effect as when drilling a hole. The brake lever can be loaded to get any desired resistance within the capacity of the machine.

By making a record of each class of drill when new, it is always possible to determine what per cent of its rated capacity it is exerting.

MAKING FLUE CUTTER KNIVES ON A MILLING MACHINE

Flue cutter knives which were formerly made at the Battle Creek, Mich., shops of the Grand Trunk, partly by machinery and then finished by hand, are now made entirely

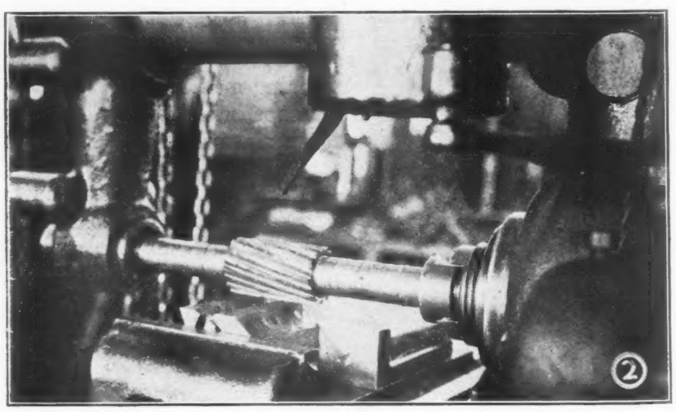


Fig. 2—Milling the Angles on Flue Cutter Knives

in the milling machine and the time required has been reduced about one-half.

The first operation is to cut the bar stock in suitable lengths to make about twelve knives. The square stock is then put in centers and straddle mills are used to mill to the required size, which is ¾ in. square. Then the stock is cut to the proper length to make the knives. The grooves are then milled in, as shown in Fig. 1. After this operation

is finished, the knives are put in a vise, using the device shown in Fig. 2, and the angles are milled. The rack cutting attachment is then used, as shown in Fig. 3, placing the knife in the device as shown and using twin mills to cut the point down to the proper width. The device is placed in the vise on the index head and the tail stock center is used as a clamp, using the index handle to turn the head.

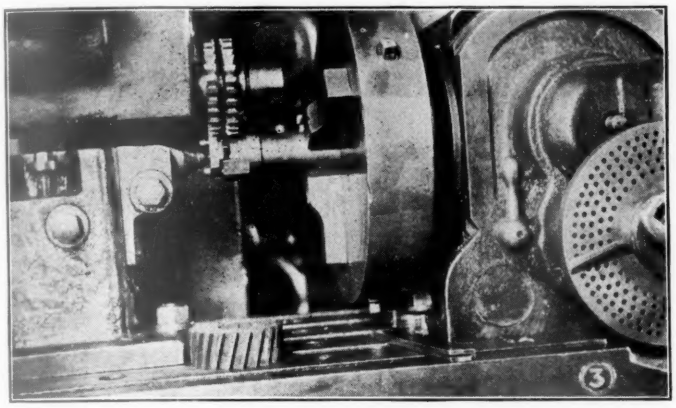


Fig. 3—Milling the Cutting Edges of Flue Cutter Knives to Width

After the points are milled, the straddle mills are removed, another cutter put on, and the other ends milled to the proper circle.

The papers on this subject were prepared by the following committee: J. J. Sheehan, chairman; P. L. Watson, J. J. Sumner, Thos. Bell and R. E. O'Hern.

Discussion

Following the presentation of the papers on this subject it became evident from the discussion that there are few tool foremen who do not have a number of special devices which they have developed for various operations in their shops. The importance of this field as a matter for the systematic consideration of the tool foreman was stressed by several members. The future of the tool room foreman lies, not in his ability to turn out satisfactory small tools and machine tool cutters, but in the extent to which he studies the problems of the other departments of the shop with a view to the development of special jigs and tools to reduce the time and labor required on machine and erecting floor operations.

ISSUING AND CHECKING TOOLS IN LOCOMO TIVE AND CAR SHOPS

BY J. B. HASTY,
A. T. & S. F.

Employees entering the service are required to sign a card form in duplicate. The original is retained by the foreman and the duplicate by the employee. Six tool checks, a hammer, monkey wrench and three chisels are furnished and entered on his card, which he retains until he leaves the service. The main tool room is located in the center of the machine shop. There are also sub-tool rooms in the boiler shop and car shop. All new or repaired tools are distributed to the sub-tool rooms from the main tool room. All small hand tools are grouped in racks with the sizes stenciled on the racks; small hooks are provided to hang the checks. Checks must be presented for all tools in the tool room, except chisels and machine tools. A supply of these is kept in the tool room and exchanged as they require redressing.

When chisels become too short for further use as chisels, they are made into center punches, drill drifts and other small tools. Machine tools are of standard sizes and when two-inch by three-inch tools become too short for further use, they are made into smaller sizes until they are worked down to $\frac{1}{4}$ in. by $\frac{1}{4}$ in. for Armstrong tool holders. Tools that require redressing are delivered to the smith shop each morning and returned to the tool room in the evening, ground and placed in racks for distribution. Pneumatic tools are returned to the tool room each evening for inspection and oiling. All tools must be turned in before quitting time on Saturday. A record is made of all checks left in the tool room over Sunday and the employees involved are taken to task for not obeying rules.

Shop goggles are kept in an inclosed case, checked out and sterilized as they are returned. If tools are lost, broken or damaged by an employee, he is required to get a clearance card properly signed by his foreman before his check is returned to him. An employee leaving the service is required to return the tool checks and tools recorded on his card to the tool room foreman, who checks them up and, if there is no shortage, signs the order for his time. In case of a shortage, explanation is demanded and unless he can give a good reason for the shortage the cost of the missing tools is deducted from his pay.

Discussion

Most of the members who took part in the discussion of this paper are using systems of issuing and checking tools similar to that described, varying in details or supplemented by periodical inspections of cupboards as a check on the operation of the system. In some cases, instead of permanently assigning cutting tools to the men, they are assigned to the machine, with a supply in the tool room for the use of men on the night shift. The importance of the tool room foreman securing the confidence of the men and of the other foremen was touched on by several members. This is necessary in order to secure the co-operation of the men in returning the tools to the tool room at the end of the job or of the day, according to the rules of the shop, and to insure that the foremen will not let irregularities pass unnoticed. In one case the monthly inspection of the shop made by the local safety committee is also utilized to locate broken and misplaced tools. To avoid the opportunity of forgery an annual change in the form of tool checks is also made in some cases.

Other Business

During the second session of the Convention H. H. LaVercombe, President, Tool Salvage Company, Detroit, Mich., described what is being done by his company in salvaging worn out milling cutters by a secret grinding process, without the necessity of heat treatment. He also referred to the method of restoring slightly worn straight flute reamers to size by a hot pressing process developed by his company.

During the closing session of the convention a moving picture showing the proper use and the abuses of twist drills was shown by the Cleveland Twist Drill Company.

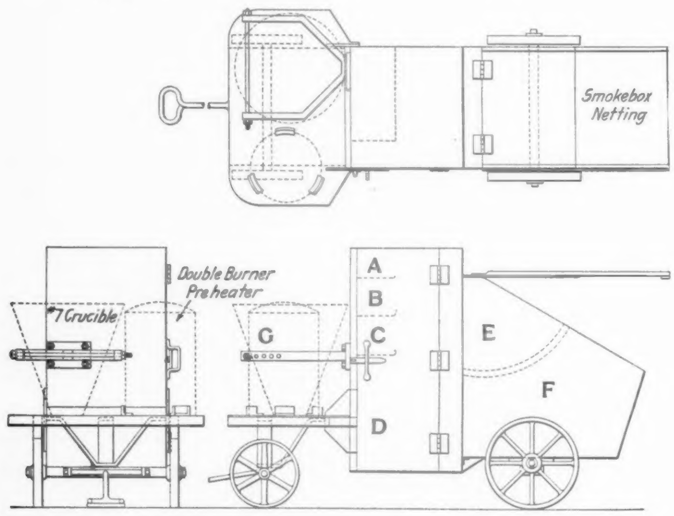
The following officers were elected for the coming year: President, J. B. Hasty (A. T. & S. F.); first vice-president, G. W. Smith (C. & O.); second vice-president, Charles Helm (C. M. & St. P.); third vice-president, Geo. Tothill (B. R. & P.), and secretary-treasurer, R. D. Fletcher (Crucible Steel Company). The following were elected members of the executive committee: P. Renfew (Big Four), chairman; T. W. Henson (Wabash), E. A. Westerman (Indiana Harbor Belt), C. Dangelmeyer (C. M. & St. P.) and C. C. Kuyper (Illinois Central).

The association voted to hold the next convention at the Hotel Sherman, Chicago.

RAILROAD CONSTRUCTION IN CENTRAL AMERICA:—Negotiations for a railroad connecting Guatemala City and Salvador which were suspended during the war, have now been resumed. The projected road will extend from Zacapa southward 157 miles to Salvador. About three years will be required to complete the work.

TOOL WAGON FOR THERMIT WELDING MATERIALS

The accompanying sketch shows a new and improved tool wagon for holding all materials and appliances for thermit welding which has been designed by the Metal and Thermit Corporation, New York. The new design provides a place for the thermit preheater at the side of the crucible. The tool wagon also contains a tool box for all necessary tools, space for mold boxes and a bin for molding material divided into two parts, the upper one for facing material and the lower for backing material. A sand screen is provided in the lower part of the lid for screening molding material when a mold is broken up to prepare it for the



The Wagon Carries Everything Needed for Making a Thermit Weld

next weld. During the screening of sand this lid is closed.

The following list shows the arrangement of the parts in the wagon:

A—Drawer for spring balance, hammer, chisel, monkey wrench and Stillson wrench.
B—Shelf for bolts and nuts, nail puller, double-end wrenches, leaf and long spoon, thimbles, ignition powder and gloves.
C—Shelf for trowel, lifter, screwdriver, pliers, slick, plugging material and vent wire.
D—Compartment for crowbar, hot blast furnace, gas, torch, rammer, mold box parts, patterns, shovel, sledge, wax in box, flaming burner and crucible holder.
E—Compartment for facing sand.
F—Compartment for molding sand.
G—Adjustable clamp for Nos. 5, 6 and 7 crucibles.

This wagon is 42 in. wide, 57 in. high to the top of the tool box and its length, exclusive of the handle, is 7 ft. 5 in. A blueprint showing the design and dimensions in more detail than the accompanying sketch can be secured from the Metal and Thermit Corporation.

MACHINE TOOL EXHIBITION IN ENGLAND

LONDON, Eng.

The machine tool industry of Great Britain not having the opportunity of exhibiting its products at the meetings of any of the engineering societies, in the manner so common in the United States, but at the same time realizing the advantages of putting on show its products, arranged a three weeks' exhibition, during September, of machine tools at "Olympia," a large exhibition hall in London. The exhibition was handled by the Machine Tool Trades Association. It was a well organized affair and full of interest to the engineering industry in Great Britain. Many of the machine tools exhibited gave actual demonstrations of the work they were designed to perform. The exhibition was open from 10.30 in the morning to 9.30 in the evening and an admission fee of two shillings (40 cents) was charged, but a large number of complimentary tickets were distributed to the trade by the exhibitors.

In connection with the exhibition two conferences were held during the last week. On Tuesday, September 21, there was a conference of employers and employed which was arranged by the Industrial League and Council during which the following subjects were discussed: "Unemployment and Production" and "High Prices and World Competition." On Wednesday, September 22, there was an Industrial "Safety First" conference held under the auspices of the Home Office and the British Industrial "Safety First" Association. On this day the morning session was presided over by the Rt. Hon. Edward Shortt, Secretary of State, Home Department, and the following papers were read: "Safety First and its Application to Industry," "The Safeguarding of Machinery" and "First Aid in the Factory." The afternoon session was presided over by Lord Leverhulme, president of the association, and papers were read on "Health, Hygiene and Safety First," "Why and How We Introduced Safety First Methods," "Notes on Safety First for a Large Factory," "Safety First in a Steel Works," "Observations on a Works Safety First Scheme," "Safety First as Applied at Port Sunlight" and "Lighting as an Aid to Safety."

A very complete catalog of some 420 pages was sold in the hall for one shilling (20 cents.) This catalog contained a complete list of all the products shown by the various exhibitors and a good deal of space was given to advertising these products.

The exhibition hall consists of a ground floor, on which was exhibited the heavy machinery, and a gallery on which were exhibited the lighter products. There were in all 167 exhibition booths. The exhibition included machine tools manufactured in Great Britain and a large number of machine tools of other countries which are handled by the machine tool agents in Great Britain. Of these American tools form by far the greatest majority. As a matter of fact the American tools were a relatively large proportion of all the tools exhibited. There were a few Swiss, French, Danish and Swedish tools shown, but no German tools.

Among the American machine tool builders represented may be mentioned the following:

Baush Machine Tool Company
Becker Milling Machine Company
Brown & Sharpe Manufacturing Company
Bullard Machine Tool Company
Carborundum Company
Chicago Pneumatic Tool Company
Cleveland Twist Drill Company
Colburn Machine Tool Company
De Vilbiss Mfg. Company
Dixon Crucible Company, Joseph
Foster Machine Company
Geometric Tool Company
Gisholt Machine Company
Gould & Eberhardt
Greaves-Klusman Tool Company
Heald Machine Company
Ingersoll Milling Company
Jacobs Mfg. Company
Kearney & Trecker Company
Landis Machine Company
Landis Tool Company
Lapointe Machine Tool Company
Le Blond Machine Tool Co., The R. K.
National Acme Co., The
Newton Machine Tool Works, Inc.
Norton Company
Potter & Johnston Machine Company
Quickwork Company
Reed-Prentice Company
Starrett Company, The L. S.
Warner & Swasey Company

The number of visitors at the exhibition demonstrated the interest which the English engineering industries displayed in it. It was very apparent that the visitors attended from no idle curiosity but for the purpose of learning how improved machine tools can be used advantageously in their work.

STEEL TREATERS MEET AT PHILADELPHIA

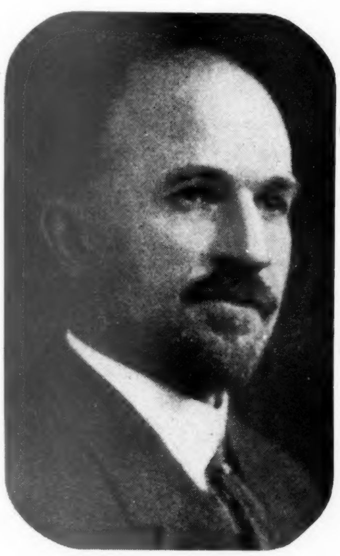
Two Steel Treating Societies Amalgamate and Hold Second Annual Convention and Exhibition

ONE of the most important steps toward a more widespread knowledge of the correct heat treatment of steel was taken at the Commercial Museum, Philadelphia, Pa., September 14, when the American Steel Treaters' Society and the Steel Treating Research Society united in a new organization known as the American Society for Steel Treating. The occasion for the union of the two societies was the second annual steel treaters' convention, lasting five days from September 14 to 18 inclusive. More than 250 members attended the opening session, which was presided over by Lt.-Col. A. E. White, chairman of the Amalgamation Committee. The total attendance for the week was 12,000

The convention was welcomed to Philadelphia by E. J. Cattell, city statistician, on behalf of Mayor Moore, who was unable to be present. Lt. Col. White responded to Mr. Cattell. Eight technical sessions were held and many important papers covering practically all phases of steel treating were read or presented by title. Some of these papers are of especial interest to railway shop men and will be abstracted in this and subsequent issues of the *Railway Mechanical Engineer.*

Lieut.-Col. A. E. White
President

T. E. Barker
First Vice-President



T. D. Lynch
Second Vice-President

W. H. Eisenman
Secretary

W. G. Bidle
Treasurer

The exhibition of all kinds of heat treating equipment and many heat treated products including forgings, die blocks, castings, tool steel, etc., was exceptionally complete and interesting. Nearly 100 manufacturers were represented on the floor of the exhibition hall and much of the equipment

was shown in actual operation. Particular comment was made on the display of stainless steel cutlery and tools and the statement was made that American manufacturers may well hope to equal, if not surpass, the famous Sheffield steels manufactured in England.

At the conclusion of the technical sessions, numerous inspection trips to industrial plants and other points of interest were made. The annual banquet and entertainment was held Thursday night, September 16, in the grand ballroom of the Bellevue-Stratford. Following the banquet the members and guests were addressed by Dr. Albert Sauveur, professor of metallurgy, Harvard University, Dr. Joseph W. Richards, secretary of the American Electro-Chemical Society and Samuel M. Vauclain, president of the Baldwin Locomotive Works, Philadelphia.

A PROCESS FOR THE MANUFACTURE OF HELICAL SPRINGS FOR HEAVY DUTY

BY T. D. LYNCH
Research Engineer, Westinghouse Electric & Mfg. Co., Pittsburgh, Pa.

Helical springs subjected to an unusually severe duty are shown in Fig. 1. They transmit the driving power of the motor to the wheels of a locomotive through gears and a set of cushion springs, the arrangement being such as to permit free vertical and lateral wheel play. In this application the stresses are tension, compression, torsion and shear, separately or in combination, and these stresses are augmented from time to time by shock, producing a condition that makes necessary a material of high elastic strength, and, at the same time, a large degree of toughness. The common practice of spring making, using carbon steel, did not produce a sufficiently reliable spring and it was found necessary to use an alloy steel specifying not only its analysis but the entire process of manufacture and testing.

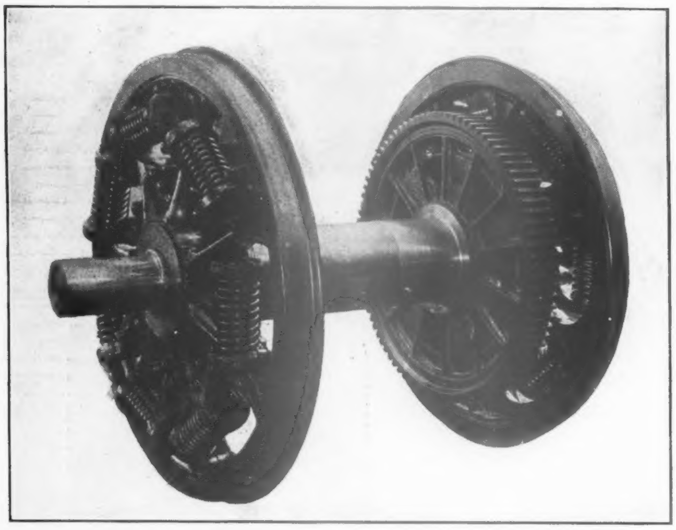


Fig 1—Driving Arrangements on Electric Locomotive Wheel

Manufacture of the Steel

The steel shall be made by the crucible or electric furnace process and have the following chemical analysis:

Carbon	.50- .60 per cent	Sulphur	Not over .04 per cent
Manganese	.60- .80 per cent	Silicon	1.90-2.20 per cent
Phosphorus	Not over .04 per cent		

The ingots shall be not less than 9 in. square at the large end and 8 in. square at smaller end, so poured and the molds so coated as to give a smooth surface to the ingot. Each ingot, when cold, shall be carefully inspected and any blemishes chipped or ground out, leaving a surface free from laps or seams after rolling. The ingots shall be slowly and carefully heated to approximately 1,100 deg. C., rolled or forged to squares of approximately 3 in. by 3 in. and sheared into suitable billet lengths for final rolling. Excessive reduction will not be permitted. Sufficient discard shall be made so that no sign of piping or segregation can be found when careful inspection is made, especially of the top cut.

The billets shall be allowed to become cold and a very careful inspection made for surface defects and any slight blemishes ground out, leaving a smooth, even surface, no ragged corners or slivers being permitted. The billets shall then be heated to approximately 1,100 deg. C. and rolled to finish size, great care being taken to avoid excessive reduction at any one pass. The bars shall be sheared to length and carefully inspected for piping, segregation and surface defects. Each bar shall be straight, free from surface cracks, scratches, seams, folds and indentations and shall be true to section. The diameter of the bar shall not vary more than two and one-half per cent from that specified. All bars shall be tied in bundles and a metal tag securely attached to each bundle. This tag shall have stamped on it the requisition number, heat number, size of rod and manufacturer's identification mark. When bundles are opened, great care must be exercised not to nick or in any way injure the bars. A nick or scratch in a bar, however small, cannot be permitted.

Coiling of Springs

The bars shall be heated slowly to a uniform temperature of approximately 925 deg. C. and immediately coiled over a mandrel preheated to at least 100 deg. C. The mandrel shall not be water cooled, nor shall any water be allowed to touch the spring while hot. Notching for length shall be done at a dull red heat and in such a manner as not to cut, scratch or otherwise injure the surface at any other point on the spring. The springs after notching shall be allowed to cool slowly and uniformly in such a manner as to prevent local chilling, which may cause surface stresses or cracks to form.

The springs shall be slowly and uniformly preheated to approximately 700 deg. C., transferred to a furnace held at a quenching temperature of 900 deg. C. and uniformly heated as near as possible to this temperature and quenched in oil. The quenched spring shall be drawn in a salt bath at approximately 455 deg. C. to relieve quenching stresses. The drawn springs shall be cleaned from the adhering salt by a hot soda wash, followed by an oil or lime dip to protect them from corrosion.

Physical Properties and Tests

The properties specified below shall be determined in the order given and the spring shall not be rapped or otherwise disturbed during the test.

(a) The solid height is the perpendicular distance between the plates of the testing machine when the spring is compressed solid with a test load at least 125 per cent of that necessary to bring all the coils in contact. The solid height shall not vary more than 1.5 per cent from that specified.

(b) The free height is the height of the spring when the load specified in (a) has been released, and is determined by placing a straight-edge across the top of the spring and measuring the perpendicular distance from the plate on which the spring stands to the straight edge, at the approximate center of the spring. The free height shall not vary more than 1.5 per cent from that specified.

(c) The loaded height is the distance between the plates of the testing machine when the specified working load is applied. The loaded height shall not vary more than 1.5 per cent over, nor more than .70 per cent under, that specified.

(d) The permanent set is the difference, if any, between

the free height and the height (measured at the same point and in a similar manner) after the spring has been compressed solid three times in rapid succession with the test load specified in (a). The permanent set shall not exceed 4 per cent of the free height.

(e) The Brinell hardness number shall not be less than 375 nor more than 450. This test shall be made on the coupon resulting from notching to length and broken off after the spring has been heat treated.

(f) The grain structure of the finished spring should be troostitic or troosto-sorbitic.

Specifications as to dimensions, packing and inspection also were included in this paper, which was intended to emphasize the great importance of a better knowledge of complete spring manufacture and bring together on common terms the designing engineer, the steel maker and the spring maker.

THE FIELD FOR HEAT TREATED LOCOMOTIVE FORGINGS

BY J. C. MARSH
Metallurgist, *Railway Mechanical Engineer*
AND C. B. BECK
Associate Editor, *Railway Mechanical Engineer*

There is hardly a forged part entering into the construction of the locomotive which is not a fit subject for heat treatment in some form, and there are none of the operations covered by the general term "heat treatment" which have not already been employed to some extent either in the manufacture or maintenance of these parts. In considering the field for heat treatment of locomotive forgings a knowledge of the conditions of service to which these parts are subjected is quite necessary. The important parts to which the present discussion will be limited are the reciprocating parts, which include piston heads, piston rods, cross head pins and main rods, and connecting rods, crank pins, axles and valve motion parts.

In varying degree these parts are all subjected to shocks and constant repetitions of alternating stresses. In a table included in the progress report* of the Committee on Fatigue Phenomena in Metals, which is acting under the joint auspices of the Engineering Foundation and the Division of Engineering of the National Research Counsel, is given the approximate service required of various structural and machine parts subjected to repeated stresses. The approximate number of repetitions of stress in the life time of these parts varies from 2,000,000 for the members of railroad bridges to 15,000,000,000 for steam turbine shafts. Next to the highest figure shown is 1,000,000,000 for steam engine piston rods, connecting rods and crank shafts. Considering the life of the average locomotive, it is probable that the same parts of the locomotive should be able to withstand from 300,000,000 to 400,000,000 stress repetitions within the time they are in service. The life of airplane engine crank shafts is given as 18,000,000 stress repetitions and that of automobile engine crank shafts as 120,000,000. These figures are only approximate but they serve to show the comparatively severe limitations which are placed on refinements of the design of locomotive parts, in order that they may successfully withstand the severe shocks and heavy repeated loads to which they are subjected during a life time which is long as compared to that expected from similar parts in automobile or aeroplane engines.

Limitations Modified by Heat Treating

It is these limitations to refinements of design which heat treatment (the term now being used in its restricted sense of quenching and drawing) has offered some promise of modifying. The greatest need for such modification is in connection with the reciprocating parts. Here the need for refinement permitting the use of lighter parts is measured not by the possible reduction in weight of the parts themselves but by the reduction of the destructive effect of the dynamic augment, that is, the vertically unbalanced centrifugal force produced by the excessive counter balance which must be placed in the driving wheels to take care of the horizontal effect of the reciprocating parts, which multiplies the effect of the weight involved by 36 to 40 times at the maximum speeds of the locomotive. Thus every pound by which the weight of reciprocating parts is reduced permits the addition of many times that amount of effective weight in some other part of the locomotive without any increase in destructive effect of the locomotive on track and bridges. The need, therefore, is for a material which may be subjected to higher working stresses alternating from a maximum load in tension to a maximum in compression (under the conditions of column loading). But owing to the large amount of clearance and wear which are permitted in locomotive bearings as compared with the bearings of other machines, each repetition of stress subjects the parts to severe shocks. No increase in working stress can, therefore, be permitted which decreases the ability of the material to withstand several hundred million of these shocks without failure.

The sizes of driving axles on modern locomotives, particularly those of the 2-10-2, or Santa Fe type, have increased to such proportions that they present a real problem in locomotive design. Sizes have increased until journals 12 in. and 13 in. in diameter are not uncommon and the difficulties from friction and wear, owing to the high peripheral speed of these large bearings, present a serious problem. Here, it is evident that the importance of being able to increase working stresses above those commonly used in the design of these parts is much greater than can be measured by the saving in weight to be effected on the locomotive as a whole. These axles in addition to the load on the bearings due to the weight of the machine, are subjected to constantly repeated combined torsion and bending stresses, each repetition involving shocks, increasing in severity as the bearings wear. The axles are also subjected to shocks from the lateral motion of the engine, acting against the rail through the wheel flanges, and from rail joints, frogs and crossings.

While the same need does not exist for reduction in the weights of crank pins as has been pointed out in the case of reciprocating parts and axles, there is no doubt but that full advantage would be taken in the design of these parts of any material offering the possibility of a higher working stress without a sacrifice of reliability. This statement probably applies with equal force to valve motion parts. The whole problem, therefore, in considering the possibilities for increasing working stresses in locomotive forged parts may be summarized as that of maintaining unimpaired the reliability of these parts to withstand fatigue stresses. Reliability—freedom from failures under sudden and severe shocks—is the first requirement for locomotive forgings; long life, the ability to resist fatigue, is the second requirement, and the third—a high working stress—must not be obtained at the sacrifice of either of the other two.

Factors of Safety

A general idea of the factors of safety considered necessary in the design of these parts may be obtained from the following table which shows the working stresses usually used in the calculations of sizes of critical sections:

Part	Working stress, lb. per sq. in.
Crank pins	17,000
Axles	23,000
Main rod stubs and straps	5,000-8,000
Piston rods	10,000

These stresses are based on carbon steel with a carbon content ranging between .38 per cent to .52 per cent with the

*See *Mechanical Engineering* for September, 1919, page 731.

following minimum physical requirements for the annealed forgings:

Tensile strength, lb. per sq. in.	80,000
Yield point	.5 tens. str.
Elongation in 2 in., per cent	18-20

In locomotive parts, as in those of all machines, the yield point or elastic limit is of considerable importance. An increase in elastic limit is always a tempting factor, in that it offers a possible reduction of cross sectional area, and a corresponding reduction in the weight of the part. Ductility, however, is the counter balance. Endurance to alternating or vibratory stresses is presumably dependent on the difference between the yield point and the ultimate load, although it is by no means an infalliable criterion. The railway mechanical engineer desires a high yield point and knows he must have a goodly percentage of elongation.

There is little difficulty in securing a considerable range of static physical characteristics by the application of heat treatment. A carbon steel with a carbon content near the lower limit of the above specifications may have its yield point raised nearly to the tensile strength of the annealed material by quenching and drawing, without reducing the elongation lower than the minimum specified. The range between the elastic limit and the ultimate load, however, is reduced, and in the case of carbon steel, grave doubts exist in the minds of some engineers as to the safety of taking advantage of these improved static properties of the material for any increase in allowable working stresses.

Another factor must be given serious consideration in connection with the employment of heat treating processes on locomotive forgings. The average conditions surrounding the maintenance of railroad motive power is such that any part, the normal working physical properties of which cannot be safely restored by the simple process of annealing, following possible repairs in the blacksmith shop, or which requires special care in machining to prevent the possibility for the development of dangerous local stresses, such as might result from rough lathe work on certain parts, has a restricted opportunity to show what it is worth. There is also an element of risk in its use, which violates the first requirement for locomotive material.

Alloy Steels

In view of the hesitancy to place full dependence on the raised yield point which may be obtained with carbon steel by suitable heat treatment, it seems evident that any extensive development toward possible increased working stresses must be largely with the alloyed steels.

With the carbon comparatively low, that is around 0.30 per cent, and the strength of the steel built up with such alloying elements as nickel, chromium, uranium, boron, copper and molybdenum, the results of heat treatment become more uniform, and an increase in ultimate strength and yield point can be obtained with less sacrifice of ductility and endurance. A slight gain in yield point may be obtained by quenching the steel and then drawing to a temperature nearly up to the quenching temperature. Some alloy steels can be heated to a point just below the critical temperature, quenched in oil and then drawn to a temperature about 400 deg. F., lower than the critical temperature, giving a yield point midway between those of the same steel in the annealed and the quenched states, with a percentage of elongation as high as the annealed steel or higher. Such steels, so heat treated, show a resistance to fatigue nearly equal to that of the annealed steel.

Other alloys have been developed which, when subjected to the simple process of annealing, produce a decided increase in ultimate load and elastic limit as compared with carbon steels of the same ductibility. Some of the vanadium steels are in this class. Such a steel having a carbon content of about .27 per cent, vanadium .17 per cent and chromium 1.0 per cent, annealed at 1,570 deg. F., develops an ultimate tensile strength of 96,000 lb., an elastic limit of 63,000 lb., with an elongation of 33 per cent in 2 in. and a reduction of area of 61 per cent. Plain carbon-vanadium steels having 20 points carbon, and .27 points vanadium, annealed at 1,475 deg. F., develop a tensile strength of 81,000 lb. and an elastic limit of 63,000 lb. with an elongation of 29.5 per cent and a reduction of area of 59.4 per cent.

Another alloy steel has recently been developed which possesses similar characteristics. This steel is a simple alloy of uranium and carbon. Tests of such a steel having a content of .12 per cent carbon and .15 per cent uranium, have shown a tensile strength of 52,000 lb., an elastic limit of 33,300 lb., a 40.5 per cent elongation and a reduction of area of 70.5 per cent after annealing. With a higher carbon content of .54 per cent and .29 per cent uranium, this steel developed a tensile strength of 101,690 lb., an elastic limit of 58,960 lb., a 23 per cent alongation and a reduction of area of 45.5 per cent.

There are a large number of steels which produce excellent results when subjected to the quenching and drawing process. Among these it may be well to mention the molybdenum steels, because of the comparatively wide temperature range within which they may be heated without detriment to their physical properties. Typical results of tests on 1¾-in. bars, heat treated full size, and machined to .505 in. in diameter, showed a hardening range from 1,400 deg. F., to 1,600 deg. F.; these test bars were quenched in water from 1,540 deg. F. The analysis is as follows:

Carbon	.26 per cent
Mg.	.60 per cent
Si.	.10 per cent
Cr.	.75 per cent
Ni.	1.96 per cent
Mo.	.56 per cent
Tensile strength	149,000 lb.
Elastic limit	120,000 lb.
Elongation in 2 in.	25 per cent
Reduction of area	68 per cent

Except for the longer life expected of the locomotive, the design of the automobile and motor truck involves much the same problems as the design of the working parts of the locomotive. The stresses to which automobile parts are subjected are quite as varying as those of locomotives. Impact stresses sustained by automobile axles are far greater in proportion to the cross section area of the axle than those to which locomotive axles are subjected. The automobile and truck axle has to resist alternating, vibratory, transverse and shock stresses. These axles are usually heat treated and their yield points are higher than those of locomotive axles per square inch of cross section area. Their dead load is comparable with that on the locomotive and their design is a factor against them as compared with those of a locomotive. Their percentage of failures is certainly not greater. The automotive field has about solved its problem by the use of heat treated alloy steels and the railways have not solved theirs at all.

Conclusions

The greatest obstacle to a rapid development in the use of heat treated locomotive parts is probably the conditions under which locomotives are maintained, together with the much greater importance of maintenance as a factor controlling the original construction in the case of the locomotive than that of the automobile. Railroad shops are seldom provided with facilities suitable for working materials which require the complicated heat treatment of pieces of large size, and practically all of the forged parts under consideration are passed through the blacksmith shop, either in the course of maintenance, or to be reclaimed for other use, in sufficient number, to make such equipment quite essential if results on a large scale are to be obtained.

The problem is by no means hopeless, but it seems evident that for the immediate future at least, the greatest possi-

bilities for development lie with alloy steels of the simplest composition, in which the greatest reliability, longest life and highest tensile strength can be developed by a simple heat treating process, not requiring too great a degree of precision.

As the effect of heat treatment on fatigue properties becomes less a matter of speculation, and the railroad world becomes better acquainted with the physical effects of the heat treating process the designer will undoubtedly be less loath to take advantage of the wider range of possibilities offered by the more complicated heat treating processes.

THE HARDENING OF HIGH SPEED STEEL

BY A. H. D'ARCAMBAL
Chief Metallurgist, Pratt & Whitney Company, Hartford, Conn.

The experiments referred to below were run primarily to determine the effects of various hardening methods on the hardness, microstructure and cutting efficiency of high speed steel. The best known brands of high speed steel made in this country and abroad were selected for these tests, the analysis of the steels being shown in Table 1. As can be seen from this table eight of the brands were made by the crucible process, the other four being melted in the electric furnace. The majority of the analyses are of the eighteen, one, four type. Steels numbered seven and twelve were both supposed to be of the high vanadium lower tungsten analysis but the vanadium in number seven steel is much lower than the desired percentage. Bar number five is an analysis quite new to this country but better known abroad. Steel number six was selected to determine if cobalt present in an eighteen, one, four type of steel added to its cutting efficiency. The forged blanks, assigned number fourteen, were made from bar number fifteen. Steels number five, eight and ten were made abroad. As it was decided to use four-inch cutters in this test, the bars were ordered four and one-fourth inches round. The Brinell hardness ran from two hundred and seventeen to two hundred and eighty-six, the only one giving trouble in machining being number five bar, but the trouble was not severe enough to make it necessary to reanneal this steel.

TABLE I—ANALYSES OF HIGH SPEED STEELS USED IN TEST

No.	Carbon	Mang.	Phos.	Sulp.	Sil.	Chrom.	Van.	Tungsten	Cobalt	Molyb.	Brinell hard	Method of manufacture
*1C	.70	.18	.017	.025	.13	3.53	.68	17.56	...	...	286	Cruc. melted
*2C	.67	.30	.016	.009	.11	3.66	.95	17.39	...	...	241	Cruc. melted
3	.65	.16	.022	.025	.24	4.70	1.02	18.45	...	...	228	Elec. fce. melted
*4	.64	.24	.017	.025	.16	3.33	1.01	18.44	...	...	228	Cruc melted
5C	.70	.18	.026	.024	.41	4.43	...	...	5.25	4.90	255	Cruc. melted
*6C	.68	.30	.014	.010	.22	3.68	.97	17.51	3.27	...	286	Elec. fce. melted
7	.70	.21	.020	.025	.31	4.45	1.18	12.65	...	...	241	Elec. fce. melted
8	.67	.14	.020	.020	.23	3.37	.97	19.05	...	...	217	Cruc. melted
10C	.62	.22	.017	.009	.14	4.14	.26	17.84	...	...	269	Elec. fce. melted
11	.63	.34	.024	.022	.15	3.89	.85	18.60	...	...	241	Cruc. melted
*12C	.80	.25	.024	.014	.14	3.57	1.75	14.70	...	...	228	Cruc. melted
14	.62	.34	.014	.023	.09	3.74	.55	17.87	...	...	217	Cruc. blank fgd.
*15	.62	.34	.014	.023	.09	3.74	.55	17.87	...	...	217	Cruc. melted

*Indicates that bars are rough turned.

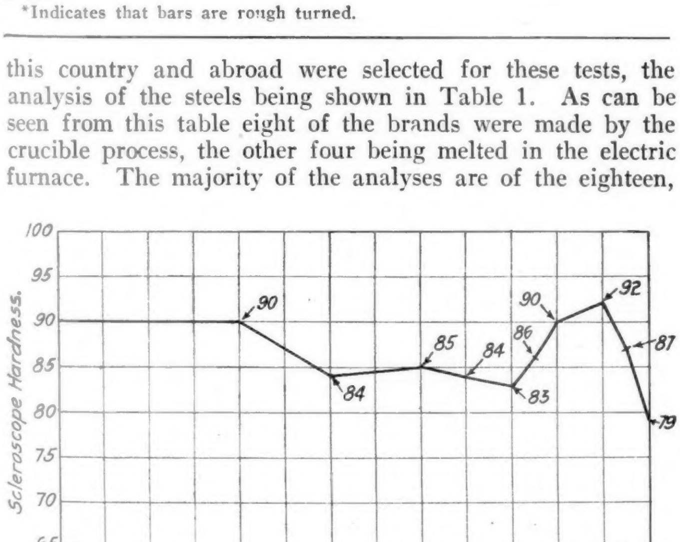


Fig. 1—Scleroscope Curve, Steel No. 1, Heated to 2,300 Deg. F, in Open Fire and Quenched Into Oil at 100 Deg. F.; Drawn at Temperatures Indicated.

Small discs were cut from some of the bars, thirteen of these being heated in the open fire furnace to 2,300 deg. F. and quenched into oil, thirteen heated in barium chloride at 2,100 deg. F. and oil quenched, and thirteen heated in a charcoal pack to about 2,050 deg. F. and oil quenched. These were then given various drawing temperatures up to 1,300 deg. F. and the scleroscope hardness taken, using a type D scleroscope (Dial recording type). The results plotted on six charts one of which is shown in Fig. 1 give the following information:

Conclusions from Scleroscope Curves

1. That the majority of brands of high speed steel when given a high quenching temperature (about 2,300 deg. F.) are just as hard or slightly harder after being drawn to 1,100-1,150 deg. F. as when quenched.

2. That 600-1,000 deg. F. is the softening range for hardened high speed steel.

3. When high speed steel is quenched from a lower temperature (2,000-2,100 deg. F.) almost the same initial scleroscope hardness is obtained as when quenched from a higher temperature, and the same characteristic curve is obtained on drawing. The lower the quenching temperature, however, the lower the temperature at which the rehardening occurs on drawing and the greater the falling off in hardness after this point is passed.

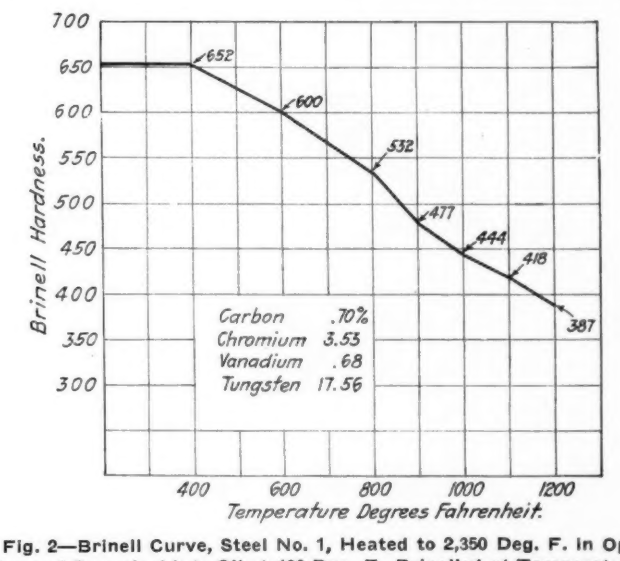


Fig. 2—Brinell Curve, Steel No. 1, Heated to 2,350 Deg. F. in Open Fire and Quenched Into Oil at 100 Deg. F., Brinelled at Temperatures Shown.

Samples which had been quenched from 2,300 deg. F. and drawn to 1,100-1,150 deg. F. were redrawn to 600 deg. F. but did not change their scleroscope hardness. This shows that the scleroscope curve obtained on redrawing a piece of hardened high speed steel which had been drawn to 1,100 deg. F. would be a straight line, instead of showing a softening range from 600-1,000 deg. F. as is obtained on the original drawing of the sample hardened from a high heat.

In order to determine the hardness of hardened high-speed steels at temperatures from 400 deg. F. to 1,200 deg. F. temperature Brinell curves were obtained as follows: five-eighths inch thick discs were cut from the four and one-fourth inch round bars of high speed steel, and these were

cut in two. These discs were then hardened and brinelled cold. The method of hardening one disc is shown in Fig. 2. They were then heated in a small electric muffle furnace, two at a time, the pyrometer placed between the two discs and touching them. The pieces were held at the desired temperature for a sufficient length of time to insure thorough soaking, and then removed from the furnace, placed on a steel block of the same temperature, and rapidly brinelled. A new Brinell ball was used for each Brinell. These impressions were read immediately after brinelling and the discs again placed in the furnace for the next higher temperature. After the Brinell at 1,200 deg. F. was taken, the pieces were quenched and again brinelled. A temperature Brinell curve on a disc of carbon tool steel, properly quenched, was also obtained for comparison. A study of the Brinell curves showed the following:

Conclusions from Brinell Curves

1. The higher the quenching temperature the greater the hardness at temperatures from 600 deg. F. to 1,200 deg. F.
2. The cobalt molydenum steel shows considerably lower temperatures, Brinell reading from 400 deg. F. to 900 deg. F. temperatures than do the tungsten steels.
3. High-speed steel quenched and drawn to 1,100 deg. F. shows a greater Brinell hardness at temperatures from 600 deg. F. to 900 deg. F. than when only drawn to 450 deg. F.
4. The temperature Brinell readings on the high-speed steel quenched from 2,300 deg. F. are all the same with one exception, at 1,100 deg. F.
5. Hardened high-speed steel, while not as high as carbon tool steel as quenched, is almost three times as hard at a lower red heat.

Cutter Tests

It was decided to use heat-treated chrome-nickel steel, similar to that used for crankshafts, connecting rods, etc., in aeroplanes and automobiles for testing these cutters. The one and five-eighths in. by two and one-half in. bars of this steel were all from the same electric furnace heat of steel, and all hardened exactly the same, giving a Brinell hardness of two hundred and sixty-nine to two hundred and seventy-seven. All sides of these bars were rough ground after hardening, removing the scale. Some of these cutters failed at the corners, others showed a uniform wearing down of the cutting edges. Table II shows the results of these tests and all figures given are the average of two cutters, making the final average in each case that of four cutters.

The cutter used was of the coarse tooth side milling type, 4 in. by 5/8 in. by 1 in. hole. The material cut was slabs 16 in. by 2 1/2 in. by 1 5/8 in. with the following analysis: carbon, .46 per cent; manganese, .60 per cent; chromium, 1.16 per cent. The physical tests (standard .505 test piece) showed: elastic limit, 112,000 lb. per square in.; tensile strength, 126,000 lb. per square in.; elongation 20 per cent; reduction of area, 54 per cent; Brinell hardness, 269. The constants were: speed, 130 ft. per min.; feed, 3 11/16 in. per min.; depth of cut, 1/8 in., and coolant, oil.

Steel number twelve, the high vanadium lower tungsten material, showed the highest cutting efficiency, the cobalt steel coming second. In every case, cutters given the 1,100 deg. F. draw showed a much greater cutting efficiency than with the 450 deg. F. draw. Cutters made from number five steel were given a quenching temperature higher than that recommended by the manufacturer, but it was decided to harden all of these cutters in exactly the same way. Cutters made from forged discs showed about twenty-five per cent greater efficiency than those machined from the same bar.

Cutters drawn to 800 deg. F. which is in the softening range, showed less efficiency than when drawn to 450 deg. F. Cutters quenched from 2,300 deg. F. into nitre at 1,100 deg. F. held there about four minutes, and oil quenched show about twice as much work as when quenched into oil and drawn to 450 deg. F., and a little more than half as much work as when given the 1,100 deg. F. draw. As nitre at 1,100 deg. F. will attack high-speed steel quenched from a high temperature, a lead bath is recommended.

TABLE II—RESULTS OF CUTTER TESTS

No. of steel	Heat treatment of steel	Inches of metal cut	Remarks
12	2,300 deg. F. Open fire, oil quenched, 450 deg. F. draw	132	
12	2,300 deg. F. Open fire, oil quenched, 1,100 deg. F. draw	214	
12	Average	173	
6	2,300 deg. F. Open fire, oil quenched, 450 deg. F. draw	107	
6	2,300 deg. F. Open fire, oil quenched, 1,100 deg. F. draw	183	
6	Average	145	
10	2.300 deg. F. Open fire, oil quenched, 450 deg. F. draw	67	
10	2,300 deg. F. Open fire, oil quenched, 1,100 deg. F. draw	216	
10	Average	142	
7	2,300 deg. F. Open fire, oil quenched, 450 deg. F. draw	88	
7	2,300 deg. F. Open fire, oil quenched, 1,100 deg. F. draw	155	
7	Average	122	
2	2,300 deg. F. Open fire, oil quenched, 450 deg. F. draw	59	
2	2,300 deg. F. Open fire, oil quenched, 1,100 deg. F. draw	182	
2	Average	121	
1	2,300 deg. F. Open fire, oil quenched, 450 deg. F. draw	60	
1	2,300 deg. F. Open fire, oil quenched, 1,100 deg. F. draw	140	
1	Average	100	
5	2,300 deg. F. Open fire, oil quenched, 450 deg. F. draw	12	
5	2,300 deg. F. Open fire, oil quenched, 1,100 deg. F. draw	65	
5	Average	39	
14	2,300 deg. F. Open fire, oil quenched, 450 deg. F. draw	88	Cutters made from forged blanks using No. 15 bar.
14	2,300 deg. F. Open fire, oil quenched, 1,100 deg. F draw	168	
14	Average	128	
15	2,300 deg. F. Open fire, oil quenched, 450 deg. F. draw	48	
15	2,300 deg. F. Open fire, oil quenched,1,100 deg. F. draw	155	
15	Average	102	
2	2,300 deg. F. Open fire, oil quenched, 800 deg. F. draw, average	54	
2	2,300 deg. F. Open fire, oil quenched into nitre at 1,100 deg. F. Not drawn. Average	111	

Precautions in Hardening High-Speed Tools

1. The tools should be thoroughly preheated, the use of two preheated furnaces being recommended, one maintained at a temperature of from 1,000 to 1,100 deg. F. and the other at a temperature from 1,500 to 1,700 deg. F.
2. The tools should be kept in the superheat only long enough for the material to come to the proper temperature. Soaking at high temperatures ruins the steel.
3. A careful selection of the quenching oil should be made as too rapid a quenching oil will cause cracks.
4. When drawing hardened high-speed steel to around 1,100 deg. F., the material should be brought up to the desired temperature with the bath, and never placed into the bath at 1,100 deg. F., as this will also produce cracks. The material should be held from ten to thirty minutes at the drawing temperature and air cooled or oil quenched.

THE FUTURE FUEL FOR THE TREATMENT OF STEEL

BY H. O. LOEBELL
Industrial Heating Dept., H. L. Doherty & Company, New York

This paper deals with the introduction, utilization and application of a fuel which will permanently solve the heating problem of industry. Important fuels of today are fuel oil, pulverized coal, and industrial manufactured gas. Fuel oil is a desirable fuel, but because of insufficient supply cannot be considered as the future fuel of our industry. Some

years ago fuel oil was selling at 2½ cents per gal. and could be obtained in any desired quantity. Today it is selling at 12 cents to 15 cents per gal. and in many cases cannot be obtained at any price. This condition brings out the importance of considering the permanency of a fuel. Powdered coal is desirable in many cases but is only an intermediate development in the final solution of the problem. Ultimately our enormous coal resources will have to be treated in such a fashion that all the valuable materials from a ton of raw bituminous coal will be obtained.

Today, it is an established fact that the most flexible and efficient heating medium is a gaseous fuel. Bituminous coal resources are practically inexhaustible and therefore afford a raw material for the production of a fuel which will be permanent. From this coal we can make a gas which is very efficient and desirable and at the same time obtain all the valuable by-products that are in the coal. Such a fuel besides being permanent will never be prohibitive in price, as our methods of gas production, distribution, and utilization are always becoming more efficient and therefore the price of our gaseous fuel will have a tendency to decrease.

Advantages of Gas Furnaces

A flexible furnace design is one of the advantages in using gaseous fuel; also there are no ashes to bother with and no storage space required for the fuel. With a gaseous fuel, the most efficient combustion is obtained with the least amount of excess air. Also the temperature of a gas furnace is easily controlled and held within 10 to 15 deg. F.

If the merit of an industrial gas is judged by its B. T. U. value per cu. ft., manufactured coal gas of a 626 B. T. U. value would be the best, blue water gas with a B. T. U. of 300 second, and producer gas third. This, however, is not true. When a gas is burned, the heat developed is immediately utilized to heat the products of combustion of the burned gases. The burned gases give up their heat to the furnace walls and materials in the furnace, therefore the true source of the heat is the heat in a unit volume of the products of combustion. Also the flame temperature is directly proportional to the heat units in a cu. ft. of the burned gases. The more B. T. U.'s per cu. ft. of the products of combustion, the higher the flame temperature. This shows that not only are more heat units available, but there is a greater temperature differential between the flame and furnace material, and therefore a greater rate of heat transfer from the gas flame to the material in the furnace. Calculations based on this reasoning show that per cu. ft. of burned gas, blue water gas has both more heat content and greater heat intensity than any other industrial gas. This means greater heat transfer, greater production and higher efficiency.

The fact that a large number of producer gas plants are in existence is no argument against the use of blue water gas or any gas made from coal where all by-products are recovered. The producer gas plant is a part of the industrial institution of the past and only cheap and abundant fuel is justification for its use. One advantage of a gas producer is that a very wide range of fuels can be gasified. In fact, almost any kind of carbonaceous material can be converted into producer gas if it does not carry too much water or is not too greatly diluted with non-combustible material. The gas formed, however, may be difficult and uneconomical to use. Although producer gas is the cheapest gas which can be made per B. T. U. at the present time, its dilution with inert gas and its chemical characteristics greatly diminish its attractiveness as an industrial fuel.

Results of Furnace Tests

In order to show the advantages of a gaseous fuel and particularly a gas with a high flame temperature such as blue water gas, the results of testing several installations, made during the past few years, may be cited. Under the best conditions of oil utilization it was found that 5½ gallons of 142,000 B. T. U. oil can be replaced by 1,000 cu. ft. of a 600 B. T. U. manufactured gas. Under conditions where oil is used with efficiency, 14 gallons of 142,000 B.T.U. per gallon oil has been replaced by 1,000 ft. of 600 B. T. U. manufactured gas. Using coke and manufactured gas, a pound of coke has been replaced by 14 ft. of coke oven gas. At a large automobile plant working on high temperature forgings, 10 B. T. U. blue water gas has been substituted for 11 B. T. U. coke oven gas or 15 B. T. U. fuel oil. Thus, the possible efficiency of utilization of a fuel is directly proportional to its flame temperature and this fact coupled with actual comparative operating results proves conclusively that the most efficient fuel is one having a high flame temperature, such as blue water gas.

Another factor of essential importance in the heat treatment of steel is the formation of the scale of oxidation of the metal. Flue gases of any fuel contain varying amounts of water vapor, carbon dioxide, carbon monoxide, and nitrogen. When the fuel is burned with an excess of air, flue gases contain an appreciable amount of oxygen. This oxygen unites with the steel, forming an undesirable oxide or scale. In order to reduce the scale effect to a minimum, it is good practice to burn fuel with a slightly insufficient amount of air so that the flue gases contain a small percentage of carbon monoxide and no oxygen. Under these conditions far better results have been obtained with a high flame temperature gaseous fuel than with fuel oil. In 200 tests run during a period of several weeks in order to determine the relative values of fuel oil and blue water gas for high temperature forging the results were decidedly in favor of the gas as follows:

1. Increased production for gas over oil....................24.6 per cent
2. Fuel saving of gas over oil on basis of oil...............27.4 per cent
3. The gas furnace showed 36.6 per cent less scaling effect than the oil furnace.
4. The oil furnace had 800 per cent more burned forgings than the gas furnace.
5. Rejections were 50 per cent more on oil furnace forgings than on gas.

Summary

The ideal fuel for the heat treatment of steel must be of the following nature: (1) It must be permanent so that all future developments and furnace installations can be utilized for many years to the greatest possible extent; (2) it must have a high efficiency of utilization. It must be a fuel that will heat the metal with absolute uniformity in the minimum amount of time; (3) the effect of flue gases of the fuel in oxidizing the metal or scale forming must be reduced to a minimum; (4) such a fuel must be suited for our industrial operations and allied with the developments of all fuel resources so that standardized fuel can be produced at large central stations. This would mean enormous production, distribution and utilization; in other words, a cheap fuel. A fuel that approaches all the requirements of the ideal fuel is blue water gas.

RELATIVE ECONOMY OF OIL, GAS, COAL AND ELECTRIC HEATED FURNACES

BY W. H. LYMAN
Gen'l Sup't, Warner Gear Company, Muncie, Ind.
AND S. A. MOULTON
Industrial Furnace Corp., Boston, Mass.

The supply of natural gas has been seriously depleted in sections where it was formerly used and is an unreliable fuel. Owing to strikes of the coal miners and transportation difficulties, the cost of coal has increased greatly, and executives have viewed with alarm the magnitude of their fuel bill. Most serious of all is the fact that the demand for gasolene, kerosene and fuel oil has so far outstripped

the rate of oil production that its price has reached a point almost prohibitive. There is, in fact, a grave question as to the length of time that fuel oil can be secured at any price.

In view of the above serious situation, it is necessary to investigate all sources of heat supply. Table III gives a list of fuels and their respective heat values and cost:

TABLE III—HEATING VALUE AND COST OF FUEL

Fuels	Heating value in B. t. u.	Cost in Central West
Oil	140,000 per gal.	10 cents per gal.
Natural gas	1,100 per cu. ft.	50 cents per 1,000 cu. ft.
City gas	650 per cu. ft.	80 cents per 1,000 cu. ft.
Water gas	300 per cu. ft.	40 cents per 1,000 cu. ft.
Producer gas	170 per cu. ft.	10 cents per 1,000 cu. ft.
Coal	12,000 per lb.	$6 per long ton
Electricity	3,412 per kwh.	1½ cents per kwh.

Temperatures up to 1,800 deg. F., may be obtained with any of the fuels in Table III, but for temperature over 1,800 deg. F., the producer gas and electricity require especially designed furnaces.

The figures shown in Table IV are based on actual tests and while certain assumptions had to be made and more or less empirical methods of deduction used, the results are substantiated by actual experience. In determining installation costs and fixed charges, the cost of installing oil and gas-fired furnaces was assumed to be $100 per sq. ft. of hearth; coal fired furnaces, $150 per sq. ft. of hearth; 100 kw. electric furnaces, $90 per kw.; and 150 kw. electric furnaces, $70 per kw. A charge of 3,000 lb. was assumed to require 8 hours' heat carburizing and 2 hours' heating. The total annual service was 7,200 hours. Fixed charges, including interest, depreciation, taxes, insurance and maintenance were estimated at 15 per cent. Extra operating labor for coal fired furnaces was figured at 60 cents per hour with one man attending to 4 furnaces.

TABLE IV—COMPARATIVE OPERATING COSTS WITH DIFFERENT FUELS

Class of fuel	Fuel per charge	Fuel cost	Installation cost	Efficiency per cent	Operating costs: Fixed charges	Extra labor	Heat	Total per chg.	Cost per lb.	Saving over oil: Per chg.	Per cent
	2	3	4	5	6	7	8	9	10	11	12
Carburizing—											
Oil	52 gals.	$0.15	$2,400	12.6	$0.40	None	$7.80	$8.20	$.00274	.....	....
Natural gas	4.4 M.	.50	2,400	18.8	.40	None	2.20	2.00	.00087	$6.20	76
City gas	8.3 M.	.80	2,400	17.0	.40	None	6.64	7.04	.00235	1.16	14
Water gas	18.7 M.	.40	2,400	16.4	.40	None	7.48	7.88	.00263	.32	3.9
Producer gas	37.3 M.	.10	2,400	14.5	.40	None	3.73	4.13	.00137	4.07	50
Coal	914 lb.	6.00	3,600	8.4	.60	$1.20	2.45	4.25	.00140	3.95	48
Electricity	500 K.W.H.	.01½	9,000	53	1.50	None	7.50	9.00	.00300	.80 loss	9.7 loss
Heating—											
Oil	30.8 gals.	.15	2,400	21.4	.10	None	4.62	4.72	.00157	.....	....
Natural gas	2.61 M.	.50	2,400	32.0	.10	None	1.30	1.40	.00047	3.32	70.5
City gas	4.9 M.	.80	2,400	28.8	.10	None	3.92	4.02	.00134	.70	14.8
Water gas	11.1 M.	.40	2,400	27.6	.10	None	4.44	4.54	.00151	.18	3.8
Producer gas	22.1 M.	.10	2,400	24.6	.10	None	2.21	2.35	.00078	2.41	51.1
Coal	486 lb.	6.00	3,600	15.75	.15	$0.30	1.30	1.75	.00058	3.32	70.3
Electricity	329 K.W.H.	.01½	10,500	81.75	.44	None	4.94	5.38	.00179	.32 loss	6.8 loss

As a result of the tests, the following conclusions may be deduced as to the relative merits of different fuels:

Relative Merits of Fuels

FUEL OIL—
- Advantages—
  1. Low first cost for installation.
  2. Convenient fuel to handle.
  3. Simplicity of installation.
- Disadvantages—
  1. High cost of fuel.
  2. Uncertainty of fuel supply.
  3. Difficulties of controlling temperature.
  4. Damage to product caused by 3.
  5. Inefficient combustion.
  6. Damage to furnaces from high temperatures when burned efficiently.
  7. Fire hazard.
  8. Continuous furnaces not practical except for large masses of metal.
  9. High labor cost due to 3, 5, 6 and 8.
  10. Short life of container boxes as compared with non-oxidizing gas fuel.

CITY GAS (Especially adapted for high grade high temperature work)—
- Advantages—
  1. High heat value.
  2. Small pipe main due to 1.
  3. Can be burned efficiently.
  4. Comparatively low temperature of combustion.
  5. Accurate temperature control.
  6. Uniform quality of product.
  7. Minimum damage to product.
  8. Simplicity of installation.
  9. Low cost of installation.
  10. Cleanliness of plant.
  11. Low fire risk.
  12. Continuous furnace practical.
  13. Low maintenance.
  14. Low labor cost.
  15. Minimum scale.
- Disadvantage—
  1. High fuel cost.

COAL (Can be used efficiently only for long heat service)—
- Advantages—
  1. High efficiency.
  2. Low fuel cost.
  3. Life of container boxes longer than with oil.
  4. Total operating cost low.
  5. Reliability of fuel supply.
  6. Stability of fuel price.
- Disadvantages—
  1. High initial cost.
  2. Repair of fire box due to high combustion temperature.
  3. Floor space occupied in coal and ash handling.
  4. Difficulty in keeping competent firemen.

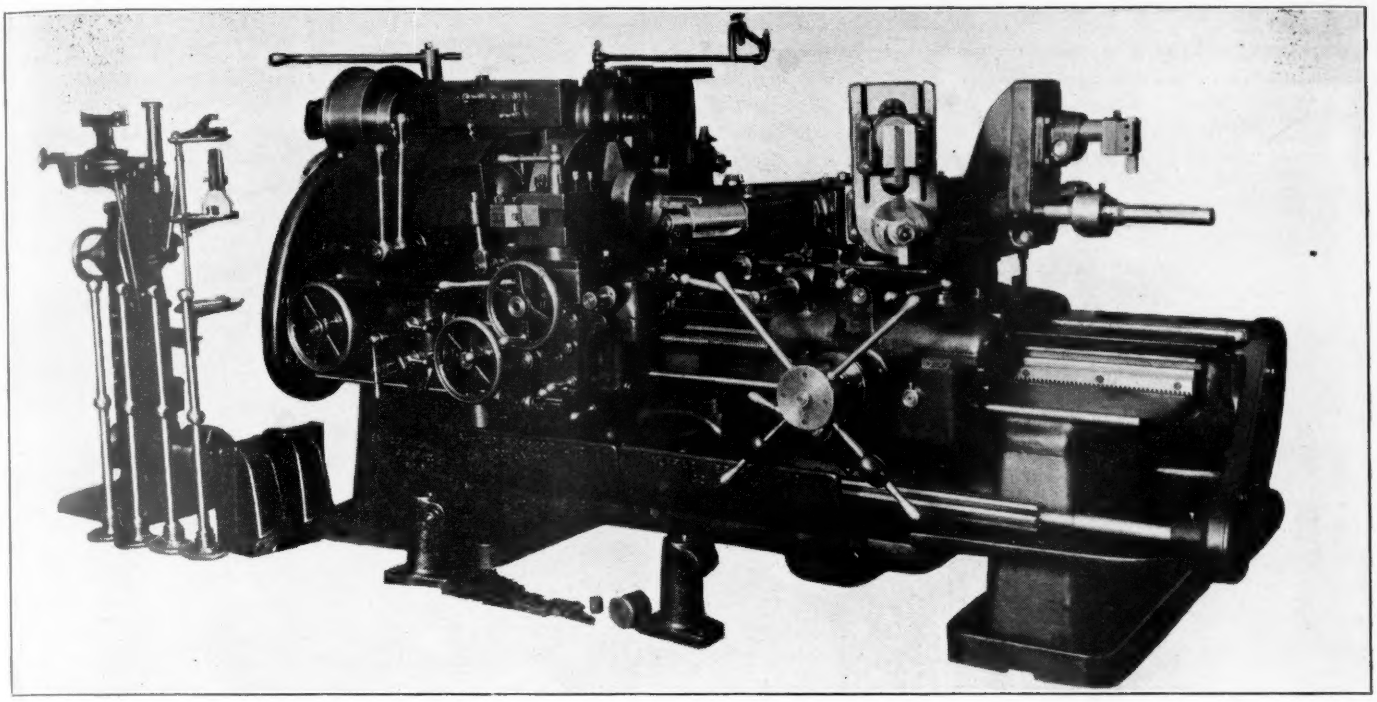
ELECTRICITY (Limited to temperatures below 2,000 deg. F.)—
- Advantages—
  1. Absolute temperature control.
  2. No high combustion temperatures.
  3. Long life of furnaces.
  4. Simplicity of installation and operation.
  5. Elimination of piping mains, pumps or blowers.
  6. Automatic continuous equipment.
  7. High efficiency.
  8. Small floor space occupied.
  9. Flexibility.
  10. Cleanly plant conditions with consequent high morale.
  11. Quality of product.
  12. No damage to product.
  13. Minimum scale.
- Disadvantage—
  1. High first cost.

Discussion of Table IV

Referring to Table IV, it will be noted that the fuel showing the greatest percentage of saving over oil in both heating and carburizing furnaces was natural gas, this favorable showing being accounted for by low fixed charges and low cost of heat. In carburizing furnaces, the fuel making the next most favorable showing was producer gas, also due to low fixed charges and low cost of heat. The cost of water gas was only slightly less than that for oil. Coal showed a considerable saving over oil due to its low cost and in spite of the fact that there was an extra labor charge. In both heating and carburizing, electric operated furnaces showed a loss as compared with oil furnaces.

Election of Officers

National officers of the American Society for Steel Treating were elected for the year 1920-21 as follows: President, Lt. Col. A. E. White, professor of chemical engineering, University of Michigan, Ann Arbor, Mich.; vice-president for two years, T. E. Barker, production engineer, Miehle Printing Press & Manufacturing Co., Chicago; vice-president for one year, T. D. Lynch, research engineer, Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa.; secretary for two years, W. H. Eisenman, 208 N. Wabash Ave., Chicago; treasurer for one year, W. S. Bidle, president W. S. Bidle Co., Cleveland, Ohio; directors for two years, H. J. Stagg, asst. manager, Halcomb Steel Co., Syracuse, N. Y., and E. J. Janitzky, metallurgist, Illinois Steel Co., South Chicago; directors for one year, F. P. Fahy, New York, and W. C. Peterson, metallurgist, Packard Motor Co., Detroit.



Example of Correct Turret Lathe Practice

A Description of the First Operations Involved in Machining a Small Clutch Gear on a Turret Lathe

BY F. S. HARMER

Railway machine shop operation can be much improved and the output increased by a more general use of turret lathes. Not only are these machines adapted to a wide variety of machine operations, but when properly set up, the amount of work that can be turned out will result in a considerable increase in machine shop output. When machining jobs within fine limits of accuracy,

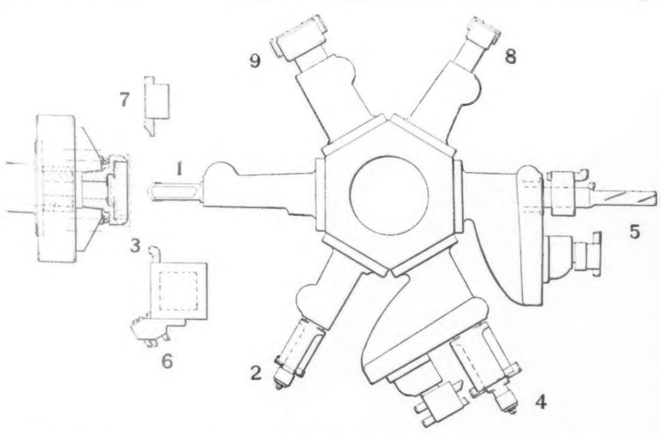
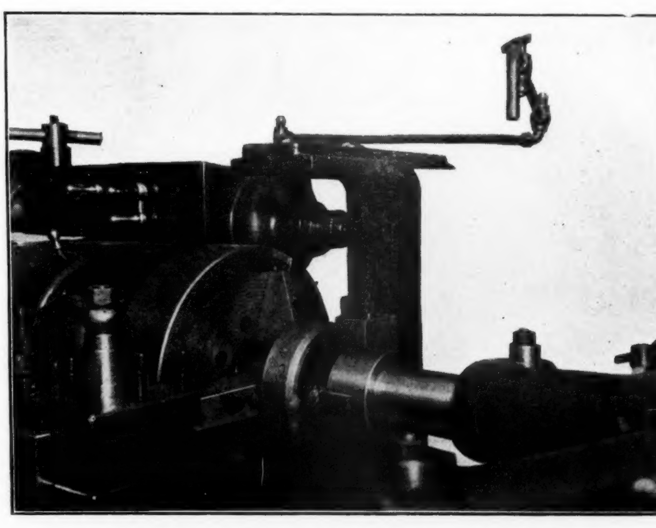


Fig. 1—Outline of Tool Set Up on Combination Turret Lathe

care must be taken in the method of machining to avoid distortion. The combination turret lathe is adaptable in this respect because of the great scope in the lay-out of the tools which makes possible a proper tool set-up to prevent undue strain of relieving in the finishing operations. The clutch gear, illustrated in Fig. 2, is made of a 70-point carbon steel forging and has some heavy counter-boring cuts, the limits in the 6-in. and 85 mm. diameter bores being within .001 in. The face setting on this piece consists of turning the 7¼-in. outside diameter, drilling and boring the larger recesses, facing the same and forming the chamfer. The piece is held in a 15-in. Coventry concentric chuck with special taper jaws for gripping the small diameter and is located with a set screw in each jaw to insure the piece be-



Tool Set Up 9; Finish Reaming 6 In. Diameter

ing chucked in the correct position relative to the stops on the machine.

Referring to Fig. 1, the forging is first drilled through with the inserted bit *1*. Drills of this type are very economical, especially in drilling long holes, as they have no tendency to bind. They consist of a mild steel shank with an inserted high speed steel bit. When breakage occurs or the

bit is ground away so far as to be of little use, the cost of replacement is much less than the cost of a twist drill of the same diameter. The next operation is counter-boring the 85 mm. diameter. This is done with the counter-boring cutter, *2*, which is steadied by a roll on the front of the bar. The cutter used is double ended and removes an equal amount

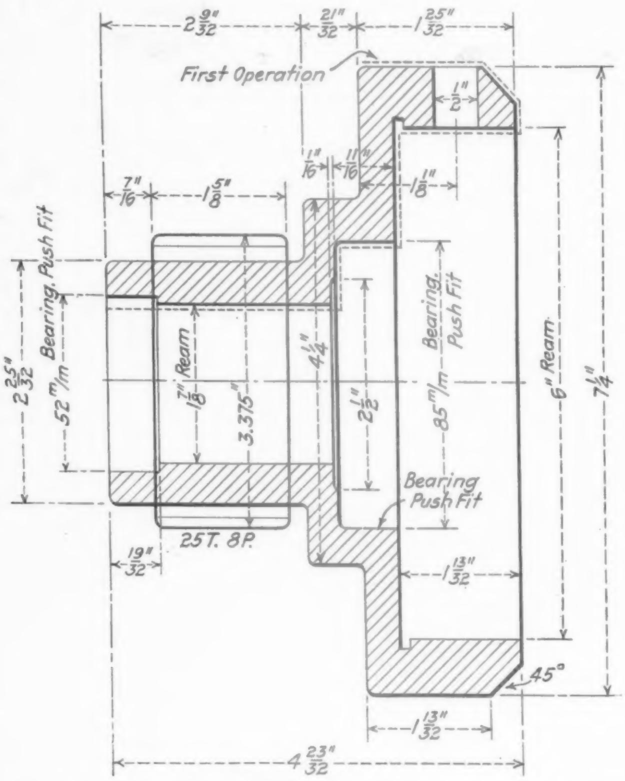
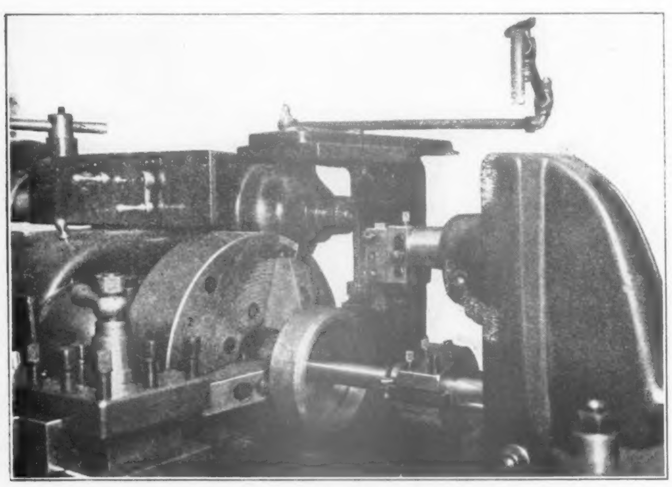


Fig. 2—Dotted Lines Indicate First Operations on Clutch Gear

of metal on either side, thus tending to steady the cutting action of the tool.

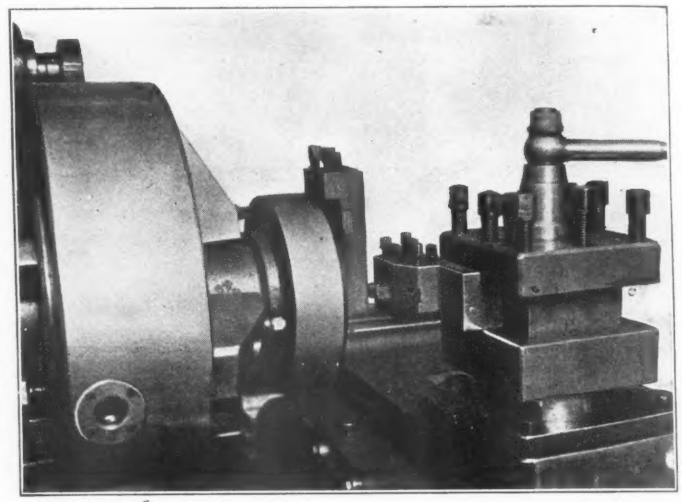
The next operation *4*, consists of counter-boring the 6-in. diameter, rough turning the 7¼-in. external diameter and rough forming the chamfer. In this operation, the counter-



Tool Set Up 5; Finish Boring and Turning Operations

boring cutter alone is removing 1 5/16-in. of metal on each side and at the same time, tool *3* is taking a rough facing cut. With the conclusion of the heavy roughing cuts the first finishing operation is to turn the 7¼-in. external diameter and bore the 85 mm. and 6-in. diameter, leaving about .007 in. for reaming with tool set up *5*. These tools consist of a boring bar with cutter for boring 85 mm. diameter and a tool in the holder clamped to the bar for boring the 6-in. diameter all held in a turning tool holder over the face of the turret. The tool for turning the external diameter is held in a fine adjustment tool holder, thus insuring quick and accurate setting. The boring tools are also adjustable by screws operating underneath them.

The two recesses are next faced and the 6-in. diameter undercut with the tools shown in tool set up *6* on the square turret. The chamfer is finished and also the front face with tool *7* inverted in the holder on the back of the cross slide. This eliminates a great deal of chatter, which



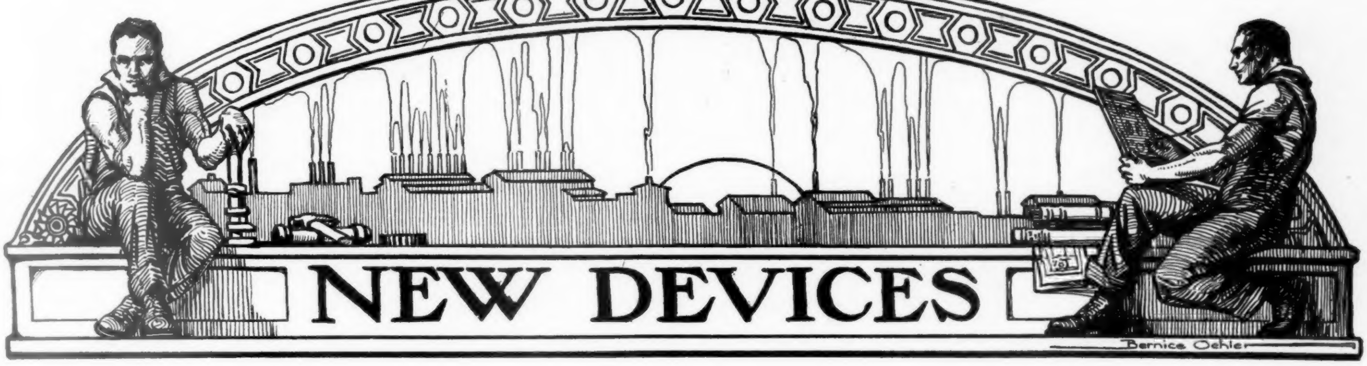
Tool Set Up 6; Recess and Undercutting Operation

is liable to occur on broad chamfers when machining from the front tool post.

The 85 mm. and 6-in. bores are finish reamed with floating cutters, *8* and *9*, each of these reamers consisting of two high-speed cutters floating in a slot in a steel holder. They have adjusting screws which enable the cutters to be kept up in size and are held in position by two filister head screws locating against a step in the back of the cutters. The heads of the screws have a flat milled way across them and when the cutters require regrinding, the screws are turned until the flat part clears the step in the cutters, which are then withdrawn. This method helps to make the regrinding a very quick operation.

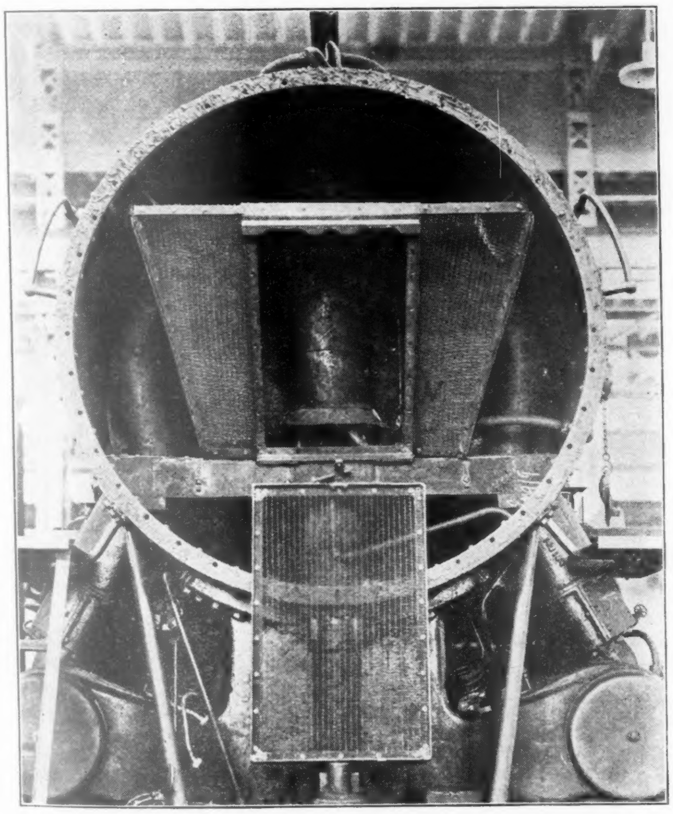
All boring tools are equipped with an oil feed from the turret giving a direct supply of lubricant to the point of cutting, thus insuring the maximum cooling and also lengthening the life of the tools.

ROTATABLE COAL HOPPER FOR LOCOMOTIVES.—Firemen on big locomotives find promise of lightened work in the rotatable coal hopper that has been invented for engine tenders. This invention is so planned that the coal is kept handy at the firing deck, making it an easy matter for the firemen to reach the coal without shoveling from the rear of the tender or using power apparatus. This special hopper is in the form of a great segmental tub, or drum, having a diameter that is the approximate width of the tender. This drum is inclined toward the firing deck; it is so mounted on a ball-bearing center plate as to turn readily. In its outer wall are openings, one for each segment, through which the coal falls by gravity. As soon as the coal is emptied from the segment, the brake that controls the drum is released. Naturally the greater weight above the center of the drum makes it rotate, bringing the next loaded segment into position.—*Scientific American.*



Quick Opening Door in Front End Netting

A FRONT end netting door, which may quickly be removed and replaced and which has sufficient area of opening to facilitate thorough and rapid inspection of the spark arrester and draft appliances, is shown in the illustrations. This device was developed and patented by John Herron, general foreman, Duluth, South Shore & Atlantic, Marquette, Mich., and the patents are controlled by Mr. Herron and John A. Higgins, Manistee, Mich. The features

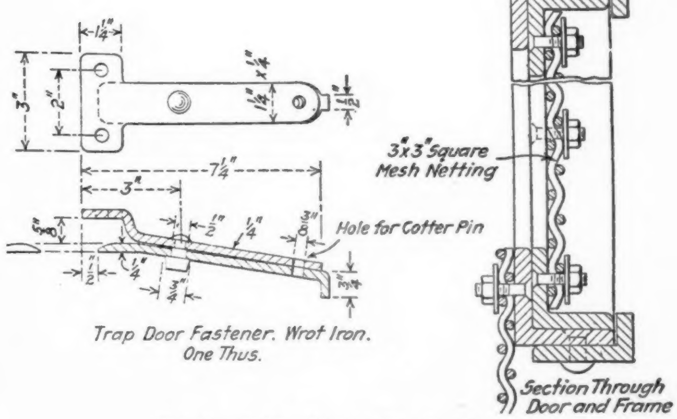


The Door Applied to a Mudge-Slater Spark Arrester

of this device which are of especial interest are the size of the door opening, the fact that it is locked in place by the use of one cotter key and the simplicity and rigidity of the door and door frame.

By referring to the drawing it will be seen that the entire device is built up of angle sections, the door itself being of ½-in. by ½-in. section, while the door frame is of 1 ¾-in. by 1¾-in. section. Both are built up by cutting 90-deg V-notches in the horizontal flanges of the angles at points corresponding to the corners, then forming the frames by bending the vertical flanges at these points and completing the structure by welding. The door and frame angles are then fitted with countersunk bolts and the netting secured in place by the application of washers and nuts. The relative sizes of the door and frame are such that the door itself fits inside of the frame with an easy working fit. The door is held in place by retaining angles riveted to the top and bottom of the door frame, the vertical flanges of which extend up or down, as the case may be, in front of the door when it is placed in the frame.

Aside from the retaining angles which prevent the door from being removed without raising it in the frame, it is also



Details of the Herron Spark Arrester

secured by a simple fastener which is locked by the use of a single cotter key in a ⅜-in. hole. This fastener, which is shown in detail in the drawing, consists of two parts, one of which is riveted to the bottom of the door. A movable piece is pivoted to the fixed piece in such a way that when it is latched under the door frame it lies under the fixed piece, to which it is immovably secured by the use of a cotter key. To unlock the door the key is removed and the movable piece turned parallel to the face of the netting, when the door may be raised and removed from the frame.

This door has been in use on a large number of the locomotives of the Duluth, South Shore & Atlantic since 1917 and is also being applied to a number of locomotives on other railroads. In many localities where there is serious danger of fires from locomotive sparks during the dry season, inspection of the spark arrester is required as frequently as once in 24 hrs. Under such conditions the convenience of a quick opening netting door of large area is apparent.

Sibley Stationary Head Drilling Machine

A NEW stationary head drilling machine built in 24 in., 26 in. and 28 in. sizes has been placed on the market recently by the Sibley Machine Company, South Bend, Ind. This machine is provided with positive geared feed, back gears and in general is modeled after the sliding head drilling machine described on page 173 of the March, 1920, *Railway Mechanical Engineer.*

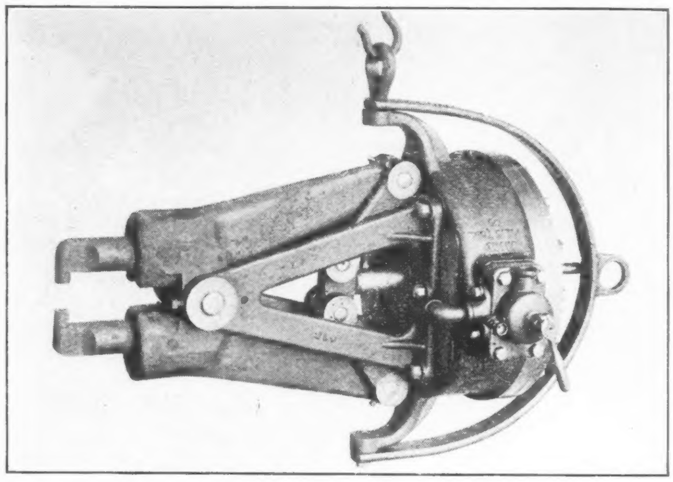
Designed to meet modern production requirements, the machine is strongly made with a base which is well ribbed and braced, with tee slots provided for clamping work. Increased length of bearings on the head and arm and a substantial table support give additional strength and accuracy. The speeds and feeds are selective and have a wide range. The spindle is balanced by a weight supported inside the column with a Diamond chain operating over large diameter sheaves. The safety of the operator is assured by enclosing the gears.

A positive geared tapping attachment, geared or belted motor drive, round or square table, with oil pump or a quarter-turn countershaft can be furnished as special equipment.

Staybolt Cutter Adapted for Riveting

THE staybolt cutter, manufactured by the Baird Pneumatic Tool Company, Kansas City, has been adapted for riveting purposes by certain alterations shown in the illustration. This makes a double purpose tool and one which has another distinct advantage, namely: adaptability for close corner work. The tool is constructed along the same principles as the regular line produced by the Baird Company, but special arms and dies enable work to be performed in extremely close corners. Fifty tons pressure exerted on the dies enables 5/16 in. rivets to be driven cold. This tool can be used to good advantage in many places which would be practically inaccessible to a hand hammer and rivets can be more uniformly driven than by hand.

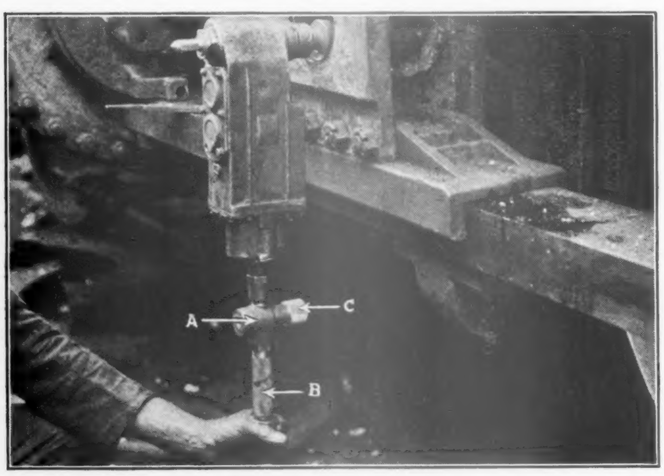
The machine is composed of a 15 in. air cylinder, the piston head of which connects directly through a powerful toggle movement with a pair of lever arms. The removable riveting dies are securely fastened in the lever arms. On account of light construction and conveniently placed control valves, the machine can be operated by one man.



Fifty Tons Pressure Is Exerted on Riveting Dies

Safety Valve for Pneumatic Motors

A PNEUMATIC safety valve combining simplicity, strength and durability, has been placed on the market by the Pneumatic Safety Valve Company, Woonsocket, R. I. This valve is designed to prevent accident to machine operators, increase production and reduce the injury and breakage of cutting tools, such as drills, reamers, taps, etc. It is made in one size only for Nos. 1, 2, 3 and 4 non-reversible rotary machines and its use does not necessitate any extensions, alterations or change from present equipment.



Safety Valve Applied to Motor

In operation the valve is attached directly to the machine in place of the customary air control handle. The air hose is then attached to a specially constructed handle furnished with each valve, and the machine operated in the usual way. The valve consists of a body *A*, control valve *B* and cap nut *C* for regulating the pressure. If the air pressure is at 85 lb., the cap nut can be turned down, thereby tightening the spring tension of the valve until air passes freely to the machine. When the cutting tool jams or binds by reason of abnormal resistance, a back pressure is instantly created within the valve chamber which closes the valve, shutting off the air and preventing the kick of the machine, which usually causes injury or damage. When the valve closes it cannot open and the machine cannot resume action until the operator closes the air control valve, which operation releases the valve to its normal position and opens the air line to resume work.

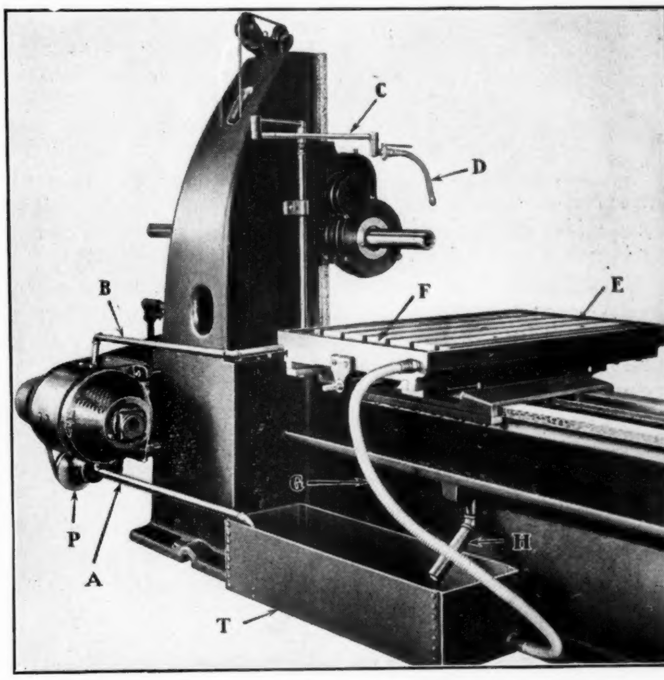
The pneumatic safety valve is made of standard design, all parts being interchangeable and can be taken apart, cleaned, oiled and reassembled in approximately three minutes. It is stated that this valve has been used in summer or winter with dependable results and withstood severe tests under all working conditions. Many accidents should be obviated by its use.

Cutting Lubricant System for Boring Machine

An efficient and complete cutting lubricant system has been applied to the horizontal boring machine manufactured by the Universal Boring Machine Company, Hudson, Mass. This addition is in line with the recent tendency of modern machine tool manufacturers to increase the production of their machines to the maximum by furnishing an abundant supply of cutting compounds or lubricant to the cutting tool. Heat must be carried away from the cutting edge of the tool where the work is being done and for this purpose it is better to supply too much rather than too little compound.

In order to supply an adequate amount of cooling compound, an impeller type pump *A* with a capacity of 12 gal. per min. is attached to the motor bracket and driven by a belt upon the motor shaft. The reservoir or tank *T* holds the excess compound which flows to the pump through an intake pipe *A*. It is stated that the impeller type pump cannot lose its prime and that chips cannot stick and clog the system because anything that enters *A* can pass through the pump and all pipes. This avoids the necessity for strainers. The impeller pump by centrifugal force sends the compound through the delivery pipe *B*, various fittings, pipes and flexible tubes *C* and *D* to the cutting edge of the tool. The flow of compound is controlled by a valve shown.

The table has oil pockets *E* and *F*, at each end connected by grooves and from oil pocket *F*, the cutting compound is delivered to tank *T* by a flexible tube *G* of ample diameter. The machine bed has oil troughs on the front and back sloping towards the center. The front trough is on a higher level than the rear and lubricant is carried from the front to the rear trough by means of a 1¾-in. pipe. The lubricant accumulates in the rear trough and passes to the tank through overflow pipe *H*. The flexible tube *D* facilitates the flow of the compound in any direction desired. The cutting lubricant system described is applied to universal boring machines only on special order.



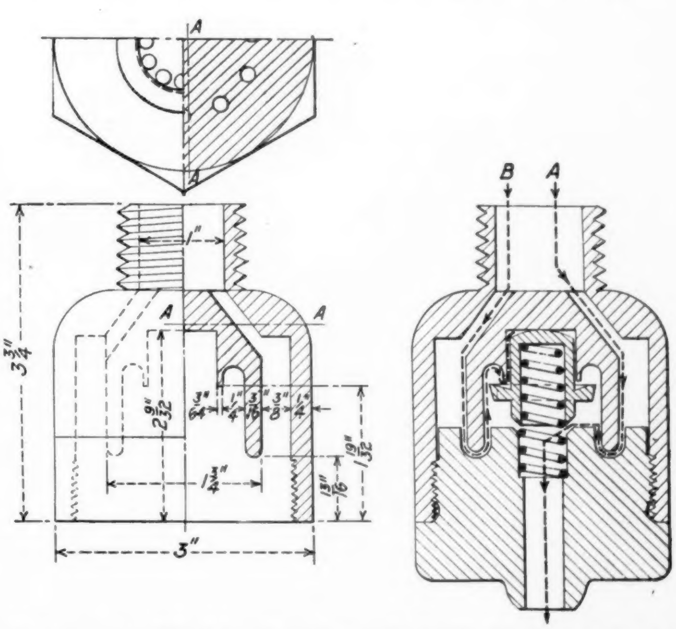
Universal Boring Machine With New Cutting Lubricant System

K & N Automatic Cylinder Cock

The automatic cylinder cock, illustrated, is simple in construction and operation, being actuated by the difference in specific gravity of steam and water, and is reported to have given satisfactory results in regular daily service for more than ten months. Cylinder cocks of this type are screwed into the cylinders in the same places previously occupied by the old style cocks. No change is required except the elimination of the train of connecting rods and levers from the cab to the cocks.

Referring to the illustration, the central valve is kept from its seat by a spring when not subjected to steam pressure. This permits unobstructed passage for water, from the cylinders to the atmosphere. When steam is turned into the pipes it forces any water which may be there ahead of it to the cylinder cocks, which remain open. The water, because of its greater weight, will not follow the same path as the steam but flows out over the valve seat in the direction *A* indicated by the arrows. When the water has drained and been blown out it leaves an unobstructed passageway for steam, which because of its greater speed and less weight follows the other path *B* shown by the arrow, bringing it in a jet against the upper face of the inclined ring mounted on the valve. The jet of steam closes the valve against the action of the spring and the interior chamber fills with dry steam which fills the cylinder where the piston travels and exerts a downward pressure on the piston. This makes the downward pressure greater than the upward pressure plus the force of the spring. The cock is kept closed as long as steam pressure is on it, but when condensation occurs, the accumulated water will shut off the admission of live steam; the valve opens due to decreased pressure, and the condensation is blown out. The same process is repeated as steam is allowed to enter the valve chamber again.

The above action eliminates the necessity of blowing out the cylinder cocks when starting and making the disagreeable alternating hissing sound which is so familiar and



Cylinder Cock Which Operates Without Levers or Connecting Rods

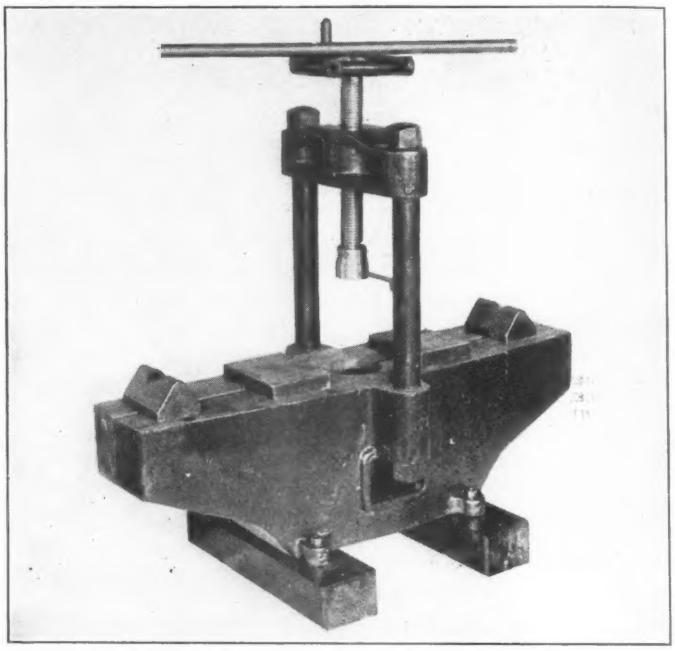
annoying. The valve remaining open precludes the possibility of freezing up in winter and the starting of engines due to leaking throttle valve. It has been proved by test that the central valve does not hammer its seat. Patents for the K & N automatic cylinder cock have been applied for by W. F. Koon and C. R. Nordberg, Duncansville, Pa.

Utility Screw Press a Handy Device

ONE of the handiest tools in a shop is a screw press. The Utility screw press illustrated can be used to straighten shafts, bars, rails, beams, etc. It is also arranged to press in or out bushings; press gears or wheels on and off shafts; and form or bend metal in many shapes. It is made by Carl Pletz & Sons, Cincinnati, Ohio.

The bed is 4 ft. long, deep and heavily ribbed with a hole cored under the screw to permit work to drop through to the floor when pressed out. These cored holes permit the pressing of pieces on or off long shafts. The two upright posts are more than strong enough to withstand any load that can be applied with the screw. A pad fits on the end of the screw and the thrust is taken on a hardened steel and bronze washer which sets in oil. The hand wheel on the end of the screw is fitted with a handle so that the screw can be returned quickly. By using a 4-ft. bar in the hand wheel, a pressure of 20 to 25 tons can be secured.

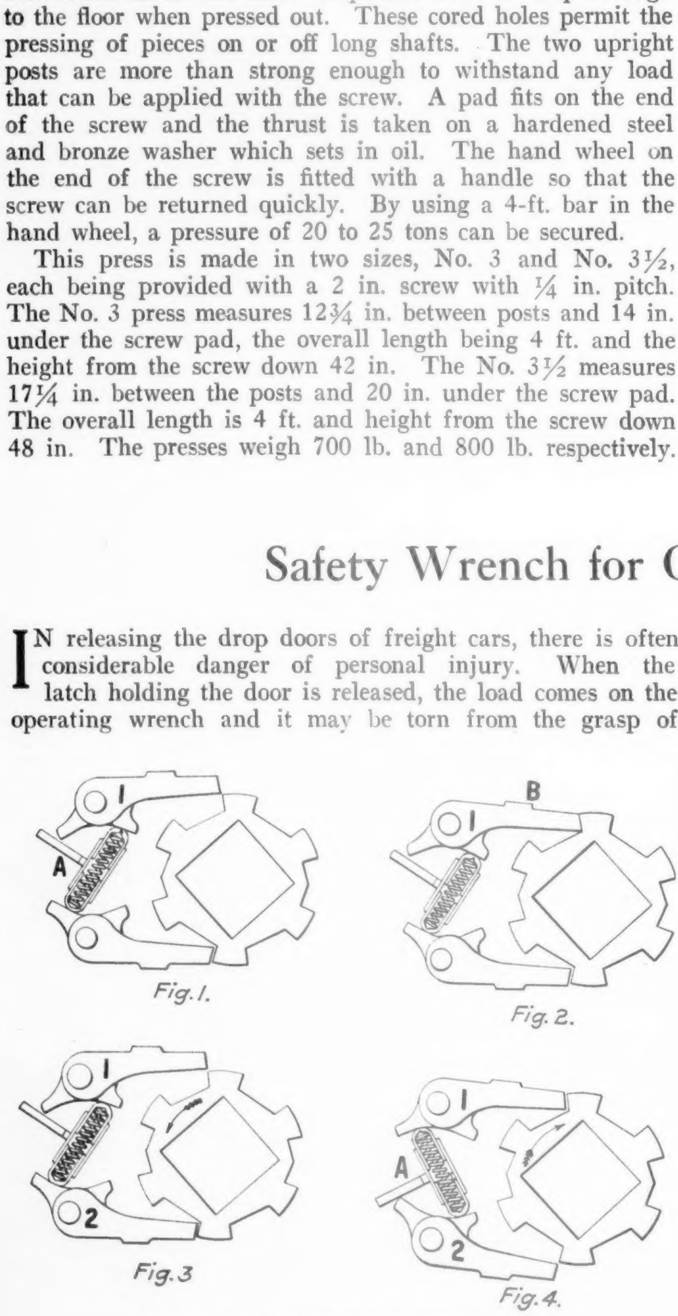
This press is made in two sizes, No. 3 and No. 3½, each being provided with a 2 in. screw with ¼ in. pitch. The No. 3 press measures 12¾ in. between posts and 14 in. under the screw pad, the overall length being 4 ft. and the height from the screw down 42 in. The No. 3½ measures 17¼ in. between the posts and 20 in. under the screw pad. The overall length is 4 ft. and height from the screw down 48 in. The presses weigh 700 lb. and 800 lb. respectively.



Utility Screw Press for Shop Work

Safety Wrench for Opening Car Hoppers

IN releasing the drop doors of freight cars, there is often considerable danger of personal injury. When the latch holding the door is released, the load comes on the operating wrench and it may be torn from the grasp of the man using it. To avoid the possibility of accident from this cause, a special type of ratchet wrench is now being made by the Safety Wrench & Appliance Co., Philadelphia, Pa. This device, which is known as the "Swaco" safety hopper car wrench, allows quick manipulation with assurance of safety.



Ratchet Mechanism of the Swaco Wrench

The mechanism of the wrench is so arranged that the top pawl is automatically thrown to the safety position when the wrench is lowered. Referring to the drawing, the operations in releasing the shaft to open the door are as follows: The spring lever, *A*, is thrown up as shown in Fig. 1, to force the top pawl *1* out of engagement with the ratchet. The wrench is then placed on the hopper shaft. By placing a finger at *B*, the pawl *1* is pressed down to engage with the ratchet. The operator then pulls up on the wrench handle to take the load off the pawl on the door frame which is lifted out of engagement, leaving the load on the wrench. By quickly lowering the wrench handle, pawl *1* is freed from the ratchet, the load rotating the ratchet in the direction shown. Should the door stick, the shaft can be revolved by pushing down on the wrench. To close the door, the spring lever, *A*, is reversed as shown in Fig. 4 to throw pawl *2* out and pawl *1* into engagement.

The "Swaco" hopper car wrench has a ball bearing head and the entire wrench is made from electric steel castings of high tensile strength. The socket is designed for holding 2 in. square shafts and bushings or reducing sockets are used to fit smaller sizes. This device is being used by railroads and also by many industrial firms.

THE AMERICAN WELDING SOCIETY has authorized the organization of a new section of the society in Cleveland. Preliminary steps have been taken and a meeting will be held shortly to effect an organization.

Railway Mechanical Engineer

(Formerly the **RAILWAY AGE GAZETTE, MECHANICAL EDITION** *with which the* **AMERICAN ENGINEER** *was incorporated)*

PUBLISHED ON THE FIRST THURSDAY OF EVERY MONTH BY THE
SIMMONS-BOARDMAN PUBLISHING COMPANY

EDWARD A. SIMMONS, *President* HENRY LEE, *Vice-President and Treasurer*
L. B. SHERMAN, *Vice-President* SAMUEL O. DUNN, *Vice-President*
CECIL R. MILLS, *Vice-President*
ROY V. WRIGHT, *Secretary*
WOOLWORTH BUILDING, NEW YORK, N. Y.
F. H. THOMPSON, Business Manager, CHICAGO

Chicago: Transportation Bldg. Cleveland: 341 The Arcade
Washington: Home Life Bldg. Cincinnati: First National Bank Bldg.
London: 34 Victoria Street, Westminster, S. W. 1.
Cable Address: Urasigmec, London

ROY V. WRIGHT, *Editor*
A. F. STUEBING, *Managing Editor* R. E. THAYER, *European Editor*
C. B. PECK, *Associate Editor* E. L. WOODWARD, *Associate Editor*
C. N. WINTER, *Associate Editor* C. W. FOSS, *Associate Editor*
L. G. PLANT, *Assocoate Editor*

Entered at the Post Office at New York, N. Y., as mail matter of the second class.

Subscriptions, including the eight daily editions of the Railway Age, published in June, in connection with the annual convention of the American Railroad Association. Section III—Mechanical, payable in advance and postage free: United States, east of the Mississippi river, $3.00 a year; west of Mississippi river and Canada, $4.00 a year; elsewhere $5.00, or £1 5s. 0d. a year. Foreign subscriptions may be paid through our London office, 34 Victoria Street, S. W. 1., in £ s. d. Single copy, 30 cents.

WE GUARANTEE, that of this issue 10,950 copies were printed; that of these 10,950 copies, 9,603 were mailed to regular paid subscribers, 13 were provided for counter and news company sales, 261 were mailed to advertisers, 32 were mailed to employees and correspondents, and 1,041 were provided for new subscriptions, samples, copies lost in the mail and office use; that the total copies printed this year to date were 116,100, an average of 11,610 copies a month.

The *Railway Mechanical Engineer* is a member of the Associated Business Papers (A. B. P.) and the Audit Bureau of Circulations (A. B. C.).

The Southern Pacific is planning to enlarge and improve its car shops in Sacramento, Cal. New buildings will be provided for the foundries, rolling mills and general shops.

The Southern Railway has put in service 1,093 freight cars since March 1, when the railways were returned to their owners; and new cars are being completed at the rate of eight cars a day. This equipment consists of 555 new steel underframe box cars and 538 steel frame coal cars, rebuilt from bad-order cars which were totally unfit for service and past the stage for economical repair.

A technical adviser from the United States has just completed a tour of inspection in connection with a large scale electrification scheme for the Austrian State Railways, according to the Scientific American. He commends the policy of the Austrian government in developing water resources to provide the necessary power and the decision to commence the work of railway electrification by converting the mountainous route to electric traction. He makes the definite statement that the electrification of the lines from the Swiss frontier to Innsbruck will save 150,000 tons of coal a year.

Chief Interchange Inspectors' and Car Foremen's Convention

The Chief Interchange Car Inspectors' and Car Foremen's Association held its twentieth annual convention at the Windsor Hotel, Montreal, P. Q., September 14-16. At the session on Tuesday morning, the convention was opened with prayer and an address of welcome was delivered by Alderman J. P. Dixon representing Mayor Martin of Montreal. T. J. O'Donnell responded to Alderman Dixon's remarks on behalf of the association. In the presidential address which followed, J. J. Gainey emphasized the benefits derived from the activities of the association in advancing knowledge regarding car construction and maintenance and promoting a uniform understanding of the A. R. A. rules and interchange matters in general. At this session there was also presented a paper on Transfers and Adjustments of Lading under the A. R. A. rules for Mechanical Defects, by J. M. Gitzen.

The meeting on Tuesday afternoon was devoted to a discussion of the A. R. A. Rules of Interchange with particular attention to the changes adopted at the June convention. This discussion was continued on Wednesday morning and at the conclusion a paper on the Transportation of Explosives was read by J. E. Grant of the Bureau of Explosives. An address on the same subject was given by J. O. O'Donnell, also representing the bureau. The influence of the work of the car department on the elimination of loss and damage to freight was discussed by E. Arnold, freight claim agent of the Grand Trunk.

Two papers were presented at the meeting on Wednesday afternoon, the first on the Lubrication of Freight and Passenger Equipment by M. J. O'Connor; the second on the Best Methods of Repairing Cars in Train Yards by O. E. Sitterly. An interesting feature of this session was the showing of moving pictures illustrating proper and improper practices in designing and maintaining brake beams and brake shoes, prepared by the Chicago Railway Equipment Company. The meeting on Thursday was devoted to the reports of committees, the election of officers and miscellaneous business.

The officers chosen for the year 1920-1921 are as follows: President, E. Pendleton, C. & A.; first vice-president, A. Armstrong, Atlanta, Ga.; second vice-president, W. F. Westall, N. Y. C.; secretary-treasurer, W. P. Elliott, T. R. R. A. of St. L. Members of the executive committee: W. H. Sherman, Grand Trunk, and A. Herbster, N. Y. C. A complete convention report will be published in the November issue.

The Railroad Administration Settling Claims

The Railroad Administration has reached a settlement in the cases of approximately 2,000 claims filed by railroad companies on account of items of additions and betterments made during the period of federal control which the companies claimed were made for war purposes or in connection with unification and, therefore, were properly chargeable to the government rather than to the companies. The greater part of the claims have been rejected, although payments were agreed upon by the Railroad Administration amounting to approximately $217,000. The claims which it has rejected or which were withdrawn during the negotiations amounted to approximately $2,000,000. The Railroad Administration has now received complete claims covering all items of account between the companies and the Railroad Administration from 43 companies.

Lehigh Valley Employee-Stockholders

More than 1,000 employees of the Lehigh Valley have purchased stock in the company and additional subscriptions are being received daily. Recently employees were advised that they might become part owners of the railroad for which they work through the purchase of stock which could be paid for on the installment plan through small monthly deductions from the payroll, as was done during the several Liberty Loan campaigns. The company buys the stock on orders from employees and they pay the price prevailing at the New York Stock Exchange on the day their orders are

received. No drive was made, President E. E. Loomis having ordered that employees were not to be urged to purchase stock, but the first 1,000 purchasers have taken an average of 4.4 shares apiece, representing an investment of approximately $200,000 at the present value of the stock. All classes of employees are represented among the purchasers, many using a part of the back pay recently received.

ALL LOCOMOTIVES ON THE M. K. & T. TEXAS LINES TO BE OIL BURNERS

Estimates compiled by the Missouri, Kansas & Texas as to the cost of operating oil-burning locomotives showed that they are more economical than those using coal, to the extent that the road is spending more than $700,000 to convert all of the 315 locomotives operating on its Texas lines to burn oil fuel. This is a statement of one of the officers of the road published in the daily press. It is expected that the transformation will be completed by January, 1921. About 160 oil-burning locomotives, both passenger and freight, are now in use on the Texas lines of the Missouri, Kansas & Texas. The cost of converting one locomotive from coal to oil burning is stated to be about $1,600. The installation of oil stations and storage tanks to serve the locomotives has been practically completed, at a cost of approximately $200,000, an oil station having been installed at practically every place where a coal filling station was located.

MEETINGS AND CONVENTIONS

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs:

Air-Brake Association.—F. M. Nellis, Room 3014, 165 Broadway, New York City.

American Railroad Association, Section III—Mechanical.—V. R. Hawthorne, 431 South Dearborn St., Chicago.
Section III.—Equipment Painting Division.—V. R. Hawthorne, Chicago.

American Railroad Association, Section VI.—Purchases and Stores.—J. P. Murphy, N. Y. C., Collinwood, Ohio.

American Railroad Master Tinners', Coppersmiths' and Pipefitters' Association.—C. B. Baker, Terminal Railroad, St. Louis, Mo.

American Railway Tool Foremen's Association.—R. D. Fletcher, 1145 E. Marquette Road, Chicago.

American Society for Testing Materials.—C. L. Warwick, University of Pennsylvania, Philadelphia, Pa.

American Society of Mechanical Engineers.—Calvin W. Rice, 29 W. Thirty-ninth St., New York.

American Society for Steel Treating.—W. H. Eisenman, 154 E. Erie St., Chicago.

Association of Railway Electrical Engineers.—Joseph A. Andreucetti, C. & N. W., Room 411 C. & N. W. Station, Chicago.

Canadian Railway Club.—W. A. Booth, 131 Charron St., Montreal, Que. Next meeting October 12, Paper on Inventions for Patents will be presented by W. P. McTeat, Patent Solicitor, 83 Craig St., West, Montreal.

Car Foremen's Association of Chicago.—Aaron Kline, 626 N. Pine Ave., Chicago. Meeting second Monday in month, except June; July and August, Hotel Morrison, Chicago.

Car Foremen's Association of St. Louis.—Thomas B. Koeneke, secretary Federal Reserve Bank Building, St. Louis, Mo. Meetings first Tuesday in month at the American Hotel Annex, St. Louis.

Central Railway Club.—H. D. Vought, 95 Liberty St., New York. Meetings second Friday in January, March, May and September, and second Thursday in November, Hotel Statler, Buffalo, N. Y.

Chief Interchange Car Inspectors' and Car Foremen's Association.—W. P. Elliott, T. R. R. A., St. Louis.

Cincinnati Railway Club.—H. Boutet, 101 Carew Building, Cincinnati, Ohio. Meetings second Tuesday in February, May, September and November.

Dixie Air Brake Club.—E. F. O'Connor, 10 West Grace St., Richmond, Va. Next meeting November 8-9, Atkin Hotel, Knoxville, Tenn.

International Railroad Master Blacksmiths' Association.—W. J. Mayer, Michigan Central, Detroit, Mich.

International Railway Fuel Association.—J. G. Crawford, 702 East 51st St., Chicago.

International Railway General Foremen's Association.—William Hall, 1061 W. Wabasha Ave., Winona, Minn.

Master Boilermakers' Association.—Harry D. Vought, 95 Liberty St., New York.

New England Railroad Club.—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass. Next meeting October 12. Paper on What the Recent Freight and Passenger Rate Increases Mean to the Public will be presented by Garritt Fort, B. & M.

New York Railroad Club.—H. D. Vought, 95 Liberty St., New York. Next meeting October 15. Paper on The Human Element in Railroading will be presented by W. S. Wollner.

Niagara Frontier Car Men's Association.—George A. J. Hochgrebe, 623 Brisbane Building, Buffalo, N. Y. Meetings third Wednesday in month, Statler Hotel, Buffalo, N. Y.

Pacific Railway Club.—W. S. Wollner, 64 Pine St., San Francisco, Cal. Next meeting October 7. Ten-minute talks on More Transportation by railroad men and shippers.

Railway Club of Pittsburgh.—J. D. Conway, 515 Grandview Ave., Pittsburgh, Pa. Meetings fourth Friday in month, except June, July and August, American Club House, Pittsburgh.

St. Louis Railway Club.—J. B. Frauenthal, Union Station, St. Louis, Mo. Next meeting October 8. Paper on Industrial Conditions will be presented by R. D. Sangster, Industrial Commissioner, St. Louis Chamber of Commerce.

Traveling Engineers' Association.—W. O. Thompson, N. Y. C. R. R., Buffalo, N. Y.

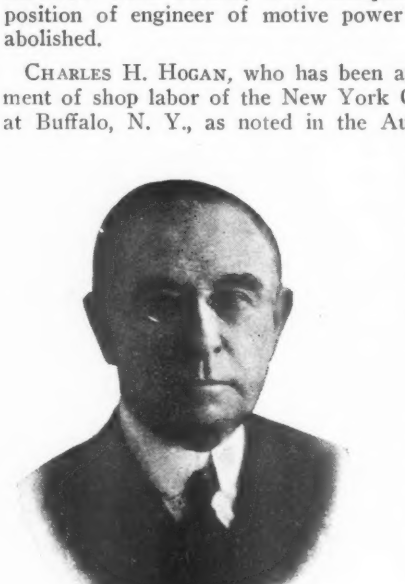
Western Railway Club.—Bruce V. Crandall, Chicago. Next meeting October 18.

PERSONAL MENTION

GENERAL

R. M. Brown has been appointed engineer of motive power of the New York Central, with headquarters at New York. The position of engineer of motive power and equipment has been abolished.

Charles H. Hogan, who has been appointed manager, department of shop labor of the New York Central, with headquarters at Buffalo, N. Y., as noted in the August *Railway Mechanical Engineer,* served as assistant superintendent of motive power of the first district, with headquarters at Albany, N. Y., previous to this promotion. Mr. Hogan was born in Cleveland, Ohio, on January 9, 1850. He received a public school education and began railroad work as a track worker for the New York Central on April 1, 1865. From 1867 to 1871 he served the Union Pacific, first as fireman and later as engineer. He then returned to the New York Central as locomotive engineer and filled that position until 1893, when he was appointed traveling engineer. In 1900 he was promoted to master mechanic and in May, 1904, he became division superintendent motive power, with headquarters at Depew, N. Y. On August 1, 1910, he was appointed assistant superintendent motive power at Albany, as mentioned above.



C. H. Hogan

Henry Wanamaker, who has been appointed district superintendent of motive power of the New York Central, with headquarters at Albany, N. Y., as noted in the August *Railway Mechanical Engineer,* served as superintendent of shops previous to this promotion. Mr. Wanamaker was born on August 5, 1866, at Pottsville, Pa. He received a high school education and began railroad work on August 1, 1884, with the Philadelphia & Reading, as a machinist apprentice. He was promoted to machinist in 1888 and served in that capacity until 1896, when he was appointed gang foreman at Reading, Pa. He left the Philadelphia & Reading in 1900 to become a foreman in the erecting shops of the New York Central at West Albany, N. Y., where he remained until 1905, when he was transferred to Depew, N. Y., as general foreman. In December, 1911, he was appointed superintendent of shops, with the same headquarters, and was transferred to West Albany on May 20, 1912.

H. Wanamaker

G. E. Doke, engineer of materials of the New York Central, with headquarters at Collinwood, Ohio, has been appointed engineer of tests, with headquarters in New York.

A. H. Eager, mechanical superintendent of the Canadian National, with headquarters at Winnipeg, Man., has been given jurisdiction over the lines of the Grand Trunk Pacific, in addition to his former duties. He will retain his former headquarters.

F. S. Gallagher has been appointed engineer of rolling stock of the New York Central, with headquarters at New York.

R. D. Hawkins, equipment engineer of the Great Northern, with headquarters at St. Paul, Minn., has been appointed general superintendent of motive power of the Atlantic Coast Line, with headquarters at Wilmington, N. C. Willard Kells has been appointed superintendent of motive power, with the same headquarters.

Laird W. Hendricks has been appointed mechanical superintendent of the Bangor & Aroostook, with headquarters at Bangor, Me., succeeding H. Shoemaker.

F. A. Linderman, district superintendent of motive power of the New York Central, with headquarters at Oswego, N. Y., has been made division superintendent of motive power.

S. J. Lupton, chief boiler inspector of the Canadian National, with headquarters at Winnipeg, Man., has been given jurisdiction, also, over the lines of the Grand Trunk Pacific.

S. Watson has been made division superintendent of motive power of the New York Central at Avis, Pa., the office of district superintendent of motive power having been abolished.

MASTER MECHANICS AND ROAD FOREMEN OF ENGINES

C. L. Bunch has been appointed master mechanic of the Southern Railway at Meridian, Miss., succeeding H. M. Little, who has resigned.

H. E. Dyke has been appointed master mechanic of the Southern Railway at Sheffield, Ala., succeeding C. L. Bunch.

Albert G. Hentz, whose appointment as master mechanic of the Harlem and Putnam divisions of the New York Central, with headquarters at West Albany, N. Y., was announced in the August issue, was born on May 20, 1889, at West Medford, Mass. He received the degree of mechanical engineer at Harvard University in 1909 and entered the employ of the New York Central on July 16, 1909, as a special apprentice at Avis, Pa. From July 1, 1911, until October 1, 1911, he served as a special engineer. He then became assistant engine-house foreman and acted in that capacity until October 1, 1912, when he was made erecting shop foreman. On July 1, 1916, he was transferred to New York city as a traveling inspector for the equipment engineering department and on July 8, 1918, was promoted to assistant master mechanic of the Mohawk division. He held that position until July 1, 1920, when his recent appointment became effective.


A. G. Hentz

E. L. Notley has been appointed division master mechanic of the Chicago, Milwaukee & St. Paul, with headquarters at Perry, Ia., succeeding C. L. Emerson.

Jesse E. Stone, whose appointment as assistant master mechanic of the Southern Pacific, with headquarters at Sparks, Nev., was announced in last month's issue, was born on June 19, 1885, at Shoshone, Idaho. He graduated from the grammar school at Pocatello, Idaho, in April, 1901, and entered the service of the Oregon Short Line on August 27, 1902, as a machinist apprentice at Pocatello. After completing his apprenticeship, on August 27, 1906, he was promoted to shop draftsman. On January 1, 1909, he was transferred to the office of the superintendent of motive power in Salt Lake City, Utah, as a mechanical draftsman. In April, 1911, he left the employ of the Oregon Short Line and for about a year was employed as a mechanical draftsman by the Ray Consolidated Copper Company at Ray, Ariz., returning to the Oregon Short Line on May 16, 1912, as assistant machine shop foreman at Ogden, Utah. On November 15, 1913, he was promoted to general foreman. On July 1, 1914, the shops at Ogden were turned back to the Southern Pacific, and he continued as general foreman there until August 1, 1920, when his recent appointment became effective.

CAR DEPARTMENT

J. Matthes has been appointed chief car inspector of the Wabash with headquarters at Decatur, Ill., succeeding J. C. Keene.

Andrew McCowan, master car builder of the Canadian National, with headquarters at Winnipeg, Man., has had his jurisdiction extended to the lines of the Grand Trunk Pacific. The change was effective September 1.

E. Hacking, master car builder of the Grand Trunk Pacific, with headquarters at Transcona, Man., has been promoted to assistant master car builder of the Canadian National, with headquarters at Winnipeg, Man.

SHOP AND ENGINEHOUSE

C. G. Henderson has been appointed general foreman of the Southern Railway at Chattanooga, Tenn., succeeding H. E. Dyke.

V. B. Story has been made general foreman of the Rock Island shops at Amarillo, Tex., succeeding S. C. Thomas, resigned.

PURCHASING AND STOREKEEPING

George W. Grossner has been appointed purchasing agent of the New Orleans Great Northern, with headquarters at New Orleans, La., succeeding William Grentzenberg, resigned.

Henry Hansen, chief clerk to the purchasing agent of the Northern Pacific, has been appointed assistant purchasing agent, with headquarters at St. Paul, Minn.

W. C. Livingstone has been appointed division storekeeper of the Pittsburgh division of the Pennsylvania, with headquarters at Derry, Pa.

OBITUARY

Isaac B. Thomas, purchasing agent of the northwestern region of the Pennsylvania with headquarters at Chicago, died on September 1 in that city. Mr. Thomas was born on June 26, 1872, at West Chester, Pa. He was graduated from Sheffield Scientific School, Yale University, in 1892. In that year he began railroad work as an apprentice at the Altoona shops of the Pennsylvania. On August 1, 1897, he was promoted to the position of inspector at the Altoona shops, and in April, 1899, was transferred as inspector to the office of the assistant engineer of motive power. On February 1, 1900, he was appointed assistant master mechanic at Renovo, Pa., returning to Altoona in 1901 as assistant engineer of motive power. On August 1, 1903, he was appointed master mechanic of the Pittsburgh shop and was transferred to the Altoona machine shop in 1906. He was promoted to superintendent of motive power of the Erie division of the Pennsylvania and also of the Northern Central, with headquarters at Williamsport, Pa., in 1911, and was appointed assistant purchasing agent of the Pennsylvania lines east of Pittsburgh in 1916. Upon the return of the road to private control he was appointed to the position he held at the time of his death.


I. B. Thomas

SUPPLY TRADE NOTES

George J. Lynch has resigned as sales manager of the Youngstown Steel Car Company, Niles, Ohio.

Joseph S. Ralston, president of the Ralston Steel Car Company, Columbus, Ohio, died in that city on September 11, at the age of 55.

J. C. Keene, chief car inspector of the Wabash at Decatur, Ill., has accepted a position with the Bradford Draft Gear Company, Chicago, Ill.

H. D. Elvidge, assistant to the advertising manager of the Reading Iron Company, Reading, Pa., has been appointed assistant advertising manager.

Agnew T. Dice, Jr., railroad sales manager of the Reading Iron Company, Reading, Pa., has been placed in charge of the cut nail business of the company.

D. M. Brown has been appointed manager for Ontario, with headquarters at 342 Adelaide street West, Toronto, of the Holden Company, Ltd., Montreal, Que., dealers in railway supplies.

The American Automatic Connector Company, Cleveland, Ohio, on October 1 opened offices and an exhibit room at 235 Railway Exchange building, Chicago, in charge of F. R. Bolles, vice-president and general manager.

The American Steam Conveyor Corporation of Chicago, Ill., announces that a change has been made in the corporate name to Conveyors Corporation of America. There is no change either in the personnel or policy of the company.

Benjamin M. McDade, formerly sales manager of the Detroit Red Lead Works, Detroit, Mich., has become associated with the railway sales department of the Sherwin-Williams Company, with headquarters at Detroit, Mich.

L. R. Day has succeeded W. E. Allison as representative in the railroad department of the Western Electric Company at Milwaukee, Wis. E. B. Dennison has been appointed manager of the new branch office at Nashville, Tenn.

C. E. Neubert, assistant district manager of the Chicago office of the Warner & Swasey Company, Cleveland, Ohio, has been promoted to district manager of the company's office in Buffalo, N. Y., to succeed W. E. Marshall, deceased.

S. W. Fries has been appointed district sales manager for Kansas City territory of the Economy Fuse & Manufacturing Company, Chicago, with offices at 1205 Commerce building, Kansas City, Mo. Mr. Fries succeeds R. P. Crawley, resigned.

John G. Talmage, president of the Talmage Manufacturing Company, Cleveland, Ohio, died suddenly in Washington, D. C., on August 25. Mr. Talmage founded the company bearing his name in 1896 and was the active head of the same up to the time of his death. Mr. Talmage contributed many appliances in the development of the locomotive.

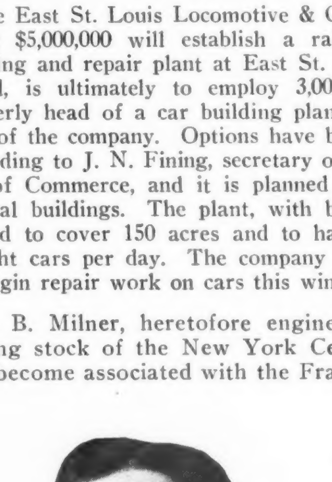
A company is being organized to construct freight car repair plants at St. Paul, Minn., and Minneapolis which will have capacities to repair 6,000 cars annually and can later be enlarged to handle 15,000 cars per year. The company is now in the market for machine tools and appliances suitable for equipping a modern plant of this type. Claude H. Siems, Alan G. Siems and C. C. Semple are the promoters and the company's headquarters are in the Guardian Life building, St. Paul, Minn.

James T. Lee has been added recently to the sales engineering staff of the Southwark Foundry & Machine Company, Philadelphia, Pa. Mr. Lee for several years past was vice-president in charge of sales of the Hanna Engineering Works, Chicago. It is the purpose of the Southwark Foundry & Machine Company to greatly broaden its field of activity by adding to its present complete line of hydraulic and power machinery a full line of pneumatic riveters and foundry molding machines.

Charles H. McCormick has been appointed western representative of the railroad department of the Standard Paint Company, New York, with headquarters in the Plymouth Building, Chicago. Mr. McCormick began railway work with the Michigan Central in the mechanical department at Bay City, Mich., and later was transferred to Jackson, Mich., and Detroit, at the latter place serving as chief clerk to the superintendent of motive power for six years. He later went to the Standard Heat and Ventilation Company, at New York and Chicago, for four years, and was with the Hegeman-Castle Corporation, at New York and Chicago, for four years previous to entering the service of the Standard Paint Company.

The East St. Louis Locomotive & Car Company, capitalized at about $5,000,000 will establish a railroad car and locomotive building and repair plant at East St. Louis, Ill. The plant, it is stated, is ultimately to employ 3,000 men. R. W. Crawford, formerly head of a car building plant at Streator, Ill., is president of the company. Options have been obtained on three sites, according to J. N. Fining, secretary of the East St. Louis Chamber of Commerce, and it is planned to begin work at once on several buildings. The plant, with buildings and tracks, is expected to cover 150 acres and to have an output of 75 to 120 freight cars per day. The company expects to be in a position to begin repair work on cars this winter.

B. B. Milner, heretofore engineer of motive power and rolling stock of the New York Central, at New York, who has become associated with the Frazar importing and exporting interests, as was announced in the *Railway Mechanical Engineer* for August, was born on November 5, 1881, at Hartford, Kans. In 1899 and 1900 he worked in the Parsons shops of the Missouri, Kansas & Texas, and later entered the mechanical engineering school of Purdue University, from which he was graduated in 1904. He then entered the service of the Pennsylvania as a special apprentice at Altoona. In 1907 he was in charge of arranging a complete revision of the machine tool layout at the Altoona shops, and later visited the principal railroad terminal points in a study of operating and maintenance of equipment methods. In 1908 he served in the office of W. W. Atterbury, then general manager at Philadelphia, on various betterment studies and was engaged in the introduction of improved operating statistical information. In May, 1911, he was appointed assistant master mechanic of the Philadelphia, Baltimore & Washington (now the Southern division of the Pennsylvania), at Wilmington, Del. In October, 1913, he left the service of the Pennsylvania to go to the New York Central as special engineer on the staff of the senior vice-president, A. H. Smith, and was sent to the Cleveland, Cincinnati, Chicago & St. Louis to assist in re-establishing satisfactory operating conditions after the disorganization precipitated by the floods of that year. He continued as special engineer on the staff of Mr. Smith, who had been made president, and later was appointed engineer of motive power of the New York Central under Chief Mechanical Engineer R. B. Kendig. In addition to duties as engineer of motive power, he handled problems in connection with car department work and the organization and administration of the test department headed by the engineer of tests. On May 10, 1917, Mr. Kendig died and Mr. Milner took over his entire work through the war and United States Railroad Adminis-



B. B. Milner

tration period. During the latter half of 1918, or until after the armistice was signed, he assisted H. A. Worcester, the Ohio-Indiana district director, with headquarters at Cincinnati. When the railroads were returned to their owners for operation on March 1, 1920, he became engineer of motive power and rolling stock, which position he held until he joined the staff of Sale & Frazar, Ltd.

W. H. S. Bateman, trading as W. H. S. Bateman & Co., Philadelphia, Pa., who for the past six years has been the eastern representative of the Canton Sheet Steel Company, has severed his connection with that company and has been appointed eastern sales agent of the Superior Sheet Steel Company, Canton, Ohio, with offices in the Commercial Trust building, Philadelphia, Pa., and 30 Church street, New York. Joseph R. Wetherald will continue as sales manager at the Philadelphia office and Richard J. Sheridan at the New York office. Mr. Bateman will continue as resident sales manager of the Parkesburg Iron Company and eastern and southern sales agent of the Champion Rivet Company, at Philadelphia.

Announcement is made of the consolidation of the Whiting Foundry Equipment Company of Harvey, Ill., and the American Foundry Equipment Company of New York. The new organization will be known as the Whiting Corporation and will maintain the same offices and manufacturing equipment. J. H. Whiting, former president of the Whiting Foundry Equipment Company, becomes chairman of the board and V. E. Minich, former president of the American Foundry Equipment Company, president. E. A. Rich, Jr., will be in charge of the plant at 2935 West Forty-seventh street, Chicago, and R. S. Buch in charge of the York, Pa., plant. The corporation plans to maintain and enlarge the former offices of the American Foundry Equipment Company at 366 Madison avenue, New York, as the eastern sales and export office.

William S. Noble, who has been appointed manager of the railroad department of the Standard Paint Company, with offices in New York and Chicago, as was announced in the September issue, was born at Danville, Ky. He began railway work in 1887 as secretary to the vice-president of the Lehigh Valley. He was later assistant in the president's office and from 1905 to 1909 was assistant to the president of the Seaboard Air Line, the Clinchfield Coal Corporation and the Carolina, Clinchfield & Ohio Railroad at New York. He then was appointed president's assistant with the Lehigh Coal & Navigation Company, Philadelphia, and in 1914 entered the service of the Standard Paint Company, New York, in its railroad department. He subsequently served as western representative, from which position he was recently promoted to manager of the railroad department of the same company.

The Titan Steel Corporation has been organized with headquarters at Newark, N. J. It has acquired the plant of the Hewitt Steel Corporation and will enlarge and re-equip the plant for maximum production, with an initial payroll of 1,500 men. The plant in question was conducted during the war for the manufacture of steel shells. Before the war it was owned by the Titan Steel Castings Company, but at the outbreak of hostilities was acquired by the Hewitt Steel Corporation for the making of steel shell castings. It is now being re-equipped for the economical production of railroad specialties. The new company has also acquired by purchase approximately two-thirds of the capital stock of the Crown Castings Company, a holding company for patent rights and privileges for the manufacture of a truck and body bolster for railroad cars. E. H. Benners, president of the holding company and patentee of the truck and bolster, is vice-president of the Titan Steel Corporation. The Titan thus obtains the use of these patents and also one for the Benners side frame, which Mr. Benners holds. H. H. Hewitt, president of the Hewitt Steel Corporation, is a director of the new company, which also has acquired the manufacturing rights of the Hewitt car trucks and journal boxes. The officers of the company are as follows: R. E. Jennings, Sr., chairman of the board; R. E. Jennings, 2nd, president; S. A. Benners, vice-president; E. H. Benners, vice-president in charge of sales; E. E. Ledogar, treasurer, and R. J. Gill, secretary.

TRADE PUBLICATIONS

PRICE LIST.—The Poole Engineering & Machine Company, Baltimore, Md., has issued a new price list covering their various machines and equipment.

MULTI-CUTTINGS.—The R. K. LeBlond Machine Tool Company, Cincinnati, Ohio, has issued a 34-page booklet descriptive of their new semi-automatic lathe.

MURRAY STEAM POWER PLANTS.—Various engines, boilers, compressors, etc., are described and illustrated in catalogue No. 85, issued by the Murray Iron Works Company, Burlington, Ia.

KELLER PNEUMATIC TOOLS.—A catalogue has been issued by the Keller Pneumatic Tool Company, Grand Haven, Mich., illustrating and describing their complete line of pneumatic tools.

PUNCHES AND SHEARS.—The Buffalo Forge Company, Buffalo, N. Y., has issued a 64-page catalogue illustrating and describing in detail their complete line of "Armor-Plate" punches and shears, bar, angle and tool cutters, etc.

MACHINE MOLDED GEARS.—The Poole Engineering & Machine Company, Baltimore, Md., has issued a new catalogue describing machine-molded gears which they have arranged according to pitch, the prime factor in determining the strength of all gears.

THE LOCOMOTIVE BOOSTER.—The Franklin Railway Supply Company, Inc., New York, has issued bulletin No. 975, describing the operation and control of the locomotive booster. Two charts show the relative increase in power by the application of the booster.

CANTON ALLIGATOR SHEARS.—The Canton Foundry & Machine Company, Canton, Ohio, has issued a 23-page catalogue illustrating and describing "Canton" semi-steel shears, built in various styles and sizes, for cutting from 1-in. square to 3-in. square, inclusive.

BOILERMAKERS' TOOLS.—The line of railway and boilermakers' supplies manufactured by the Lovejoy Tool Company, Chicago, is listed and briefly described in catalogue No. 10, containing 32 pages, illustrated. The line includes ratchets, drilling posts, punches and dies, expanders, flue cutters, pneumatic hammers, rivet forges and ball bearing jacks for railroad use.

CHAIN BLOCKS.—The Machine Shop issue of Hoisting Hints, published by the Yale & Towne Manufacturing Company, Stamford, Conn., contains a number of illustrations of Yale spur gear chain blocks handling heavy lifting operations in machine shops of many industries. These hoists are made in 17 sizes, with capacities ranging from ¼ to 40 tons, the booklet containing prices and specifications.

RADIAGRAPH CUTTING TORCH.—The Davis-Bournonville Company, Jersey City, N. J., has issued a bulletin describing the No. 1A Radiagraph. This is a portable, mechanically operated cutting torch for cutting and beveling plate and structural steel. It cuts to straight and circular lines and when the torch is set at an angle bevels the edges of boiler plates. The bulletin shows some characteristic cutting done with it.

FORGING PRESSES.—Bulletin No. 19, containing 24 pages, has been prepared for distribution by the Morgan Engineering Company, Alliance, Ohio, describing briefly the steam hydraulic forging presses built by this company, which consist of single frame types built in sizes from 150 to 500 tons capacity and four-column types up to 12,000 tons capacity. A general arrangement drawing of a typical modern forging shop is included in the bulletin.

LATERAL MOTION DRIVING BOX.—Means for increasing the capacity of narrow-gage locomotives by the use of the Franklin lateral motion driving box and the Economy engine truck are described in bulletin 77, a four-page pamphlet issued by the Franklin Railway Supply Company, New York. These devices permit the use of an extra pair of driving wheels, with a corresponding increase in the tractive power of the locomotive. A line drawing shows the arrangement of the box and flexible side rods.

INSTRUCTION BOOK FOR WELDERS.—A new edition of the Eveready instruction book distributed by the Oxweld Acetylene Com-

pany, Chicago, is a comprehensive treatise on every-day oxy-acetylene welding and cutting. It is a compact reference book, containing 55 pages, 5 in. by 8 in., illustrated. Practical information on modern practices in welding and cutting is presented in a manner so that it can be easily grasped by the beginner, at the same time being valuable to the experienced welder and cutter.

Hammers.—A Captain of Industry is the title of a booklet published by the David Maydole Hammer Company, Norwich, N. Y. It contains a brief story of the life of David Maydole, the inventor of the adz-eye hammer, written by James Parton. In addition it includes a catalogue of the principal varieties of hammers made by the company and an amount of useful information for mechanics, which has been compiled mostly in tabular form, showing the weights and specific gravity of materials of various kinds, speeds of wheels and drills, rules for calculating measurements, etc.

Carbon Dioxide Recorder.—Bulletin No. 111 describing the style "U" Uehling carbon dioxide recording equipment has been issued by the Uehling Instrument Company, New York. This new design is built in single and multiple unit forms. The bulletin shows the principle of operation involved and explains the speedy action resulting from a new form of aspirator. Absence of chemical solutions, simplicity, and an auxiliary boiler front CO_2 indicator to guide the firemen, are explained as additional advantages. The recorder itself installed in the chief engineer's office makes a continuous record of CO_2 in the flue gases.

Bolt, Nut and Rivet Machinery.—A complete line of equipment for the manufacture of bolts and nuts is described in catalogue No. 20, issued by the Acme Machinery Company, Cleveland, Ohio. The machines include single and multiple bolt cutters with or without power feed and lead screws, special staybolt cutters, bolt pointers, nut tappers, nut burring machines, nut machines, bolt machines and upsetting and forging machines. The Acme die head manufactured by this company is also described and instructions are given for making or recutting dies. A set of tables of data pertaining to screw threads, bolts, nuts and rivets is included.

Bearings and Their Lubrication.—The Vacuum Oil Company, New York, has published a 32-page pamphlet which contains an extended discussion of the lubrication of various forms of bearings. The subject is introduced by illustrating and describing the more common forms of bearings used on various types of machinery. This is followed by a brief description of the usual method of applying the lubrication either directly or through distributing systems. Space is also given to the general discussion of lubrication in relation to the quality of oil; and the latter part of the publication is devoted to considerations affecting the selection of oil for any given purpose.

Welding Torches.—The Air Reduction Sales Company, New York, has issued a catalogue describing its new line of Airco "A" and "B" welding torches. The booklet has been made as complete as possible in order to give a clear understanding of the principles of torch operation involved in the construction of the Airco apparatus and their relation to good welding. The catalogue is well illustrated with half-tone reproductions of the full line of torches, angles of heads, tips, etc. Tables are given showing the thicknesses of metal that can be welded.

Steam Tables for Condenser Work.—The Wheeler Condenser & Engineering Company, Carteret, N. J., has published the fifth edition of its handbook of steam tables. The booklet is of convenient size and is illustrated. It gives the properties of saturated steam from 29.8 in. vacuum to atmospheric pressure in increments of tenths of an inch, with pressures below atmosphere expressed in inches of mercury referred to a 30-in. barometer. A complete table is also given of the properties of saturated steam above atmospheric pressure, with constants and tables for correcting vacuum column and barometer readings, such as thermal expansion of mercury, relative expansion of mercury and brass scale, etc.

Thermit Pipe Welding.—The Metal & Thermit Corporation, New York, has issued the third edition of its thermit pipe welding pamphlet, No. 16. In the new edition the subject of thermit pipe welding has been revised and brought up to date. The making of thermit pipe welds is described in detail. The pamphlet also contains reports on successful tensile strength and vibration tests of thermit welds conducted by Stevens Institute, and a chart showing the comparatively low cost of a thermit welded pipe as compared with the cost of installing compression flanges with bolts and gaskets. The new edition also contains an account of a 10-year pipe test during which 700 ft. of 4-in. thermit welded pipe was constantly subjected to a hydraulic pressure of 1,500 lb. per sq. in., without requiring any attention.

Automatic Connectors.—A Performance Record of the American Automatic Connector, a booklet of 16 pages published by the American Automatic Connector Company, Cleveland, Ohio, presents the results that have been accomplished through the use of this equipment on 24 steel and 76 wooden hopper ore cars, 20 passenger cars and nine locomotives on the Copper Range Railroad. These connectors were installed more than a year ago and the trains were operated in what is possibly the worst snow region on this continent. An accurate record was kept by the railroad company of the cost of maintenance, the cause for each part renewed was determined and the results obtained through the use of the connectors were carefully analyzed. These have now been published in the booklet mentioned.

Greetings From the Texas Company.—A small booklet entitled "Howdy," was issued by the Texas Company, New York, to delegates attending the American Railroad Association convention, at Atlantic City. The booklet acquainted convention delegates with some interesting facts regarding the Texas Company. A discussion of railroad lubrication was given by George L. Noble, vice-president and general manager of the railroad sales department and conditions in the New York and Chicago fields were described by the respective department managers. Attention was called to the provision in some localities for spray oiling the rails in order to prevent corrosion and rust, using a specially designed car for this purpose. The last few pages of the booklet give a brief but interesting account of the activities of the Texas Company, outlining the fields covered by the different departments.

Stationary Boilers.—An interesting and well-illustrated 86-page catalogue, entitled Boiler Logic, has been issued by the Heine Safety Boiler Company, St. Louis, Mo. It contains a large amount of valuable information regarding boiler design, such as proper mixture of the gases, heat transmission by radiation, by convection and by transmission through the tubes to the water. Practical methods of baffling water tube boilers are described, with emphasis laid on flexibility of design, prevention of leakage, active and inactive surfaces, and ease of cleaning. Illustrations and descriptions are given of Heine boilers arranged for hand firing with bituminous or anthracite coal. Various kinds of stokers, including chain grate, side feed and underfeed stokers, are described. The catalogue illustrates different arrangements for burning fuels, including oil, shavings, bagasse and gas. Several pages are devoted to the overloading of boilers and a chart shows the relation between boiler load and excess of flue gas temperature over steam temperature. The last part takes up the design, construction and methods of shipping of Heine boilers.

Instruction Book for Grinding Machine.—The Heald Machine Company, Worcester, Mass., has issued a new instruction book explaining the operation and adjustment of the Heald No. 60 cylinder grinding machine, which contains a number of new features. It includes diagrams of floor plans, fan layouts, etc., making it unnecessary to use blueprints, and the instructions include not only those for adjusting the machine, but also for setting up. There is also a section on the selection of the proper grinding wheels. Wet and dry grinding is also taken up, as well as speeds and feeds and the various size arms which the company is in a position to furnish. At the back of the book is a section devoted to repair parts. In it, instead of the usual long list of names and numbers of the various parts and photographs of them, there are a number of line drawings, the first one being of the entire machine, which is termed the master chart. When a part is broken the operator, who has the machine in front of him and knows the location from which the part came, can turn to the chart designated on the master chart, which will show that particular section or unit of the machine and the part number he desires. This number, together with the serial number of the machine, will make it possible to furnish the exact piece required and guarantee interchangeability. The book contains 80 pages, 6 in. by 9 in., and is known as bulletin 501A.